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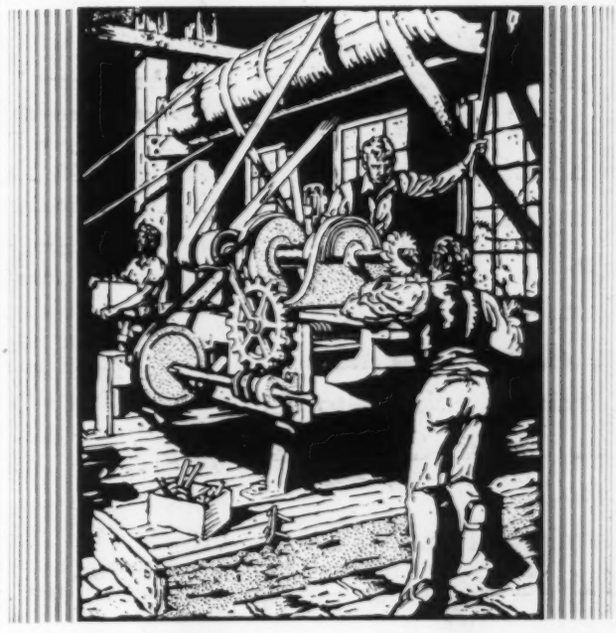

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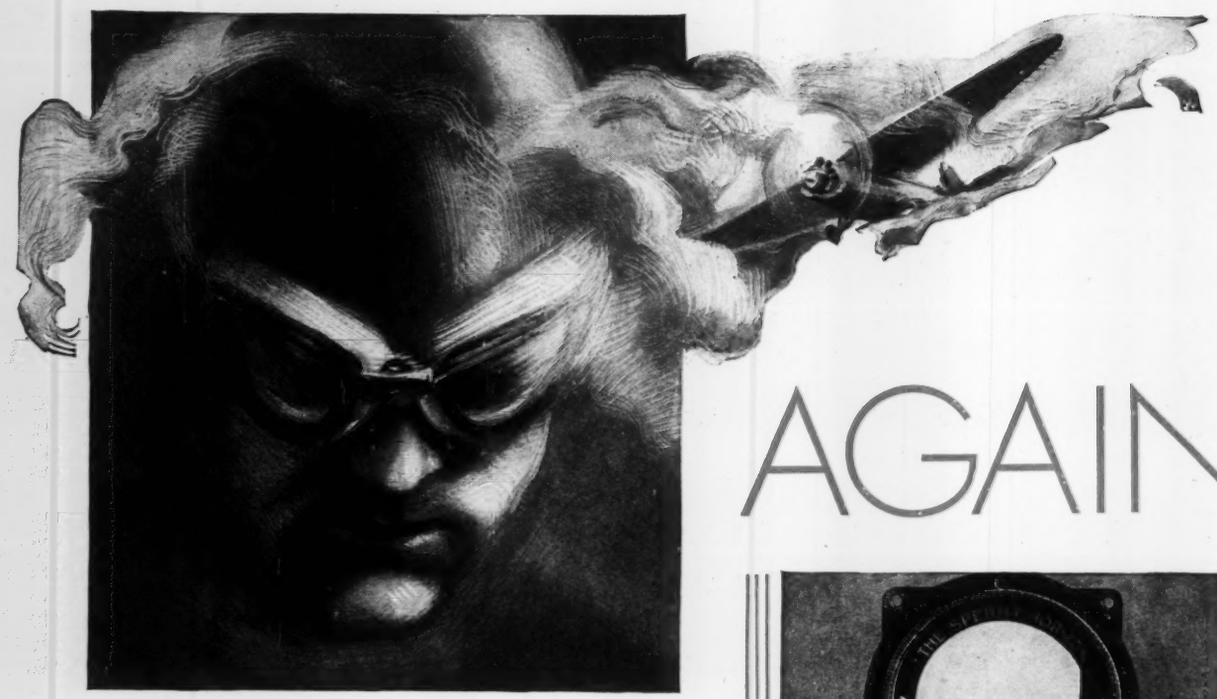

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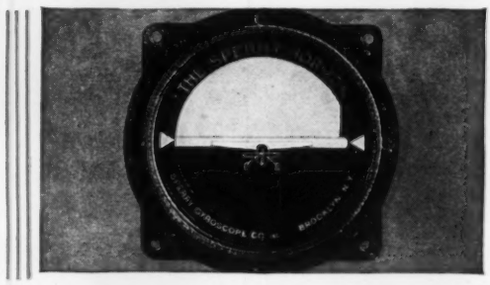

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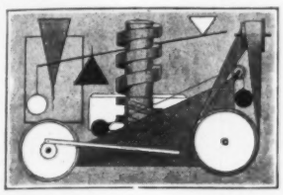
as it affects

ENGINEERING–PRODUCTION–SALES

Volume 3 | May, 1931 | Number 5



In This ISSUE

SPECIAL attention is drawn to this month's leading article. Though the subject covered is one of paramount importance it has received scant consideration in the past. We believe therefore that the contribution will be read with interest not only by members of the design profession but by other engineers identified with design work.

In later issues it is proposed to publish other articles dealing with similar pertinent topics. Isolation of the design department is undesirable and it is expected that one result of these discussions will be to bring about closer relationship between the engineering staff and those of other departments.

L. E. Jermy.
Managing Editor

CONTENTS

	Page
Shall We Revise Our Conceptions of Engineering Functions? *By L. E. Jermy*	23
Scanning the Field for Ideas	26
The Heart of the Autogiro—The Rotor Hub *By Joseph S. Pecker*	29
Performing Mechanical Operations by Pneumatic Devices *By A. F. Clark*	33
Steel Castings as Machine Parts *By R. A. Bull*	37
Considering Machine Finishes from the Sales Standpoint *By William J. Miskella*	41
Mechanical Difficulties Overcome in Welding of Spiral Pipe *By Leon Cammen*	43
Improving Drafting Management by Squad Organization *By F. D. Newbury*	46
Roller Friction Clutch Unit Is Simple and Accurate *By George T. Chapman*	48
Work Graphs Visualize Personnel Activities *By L. F. Remington*	49
Do Chief Engineers View Their Positions in Correct Perspective? (Editorial)	50
A Century's Evolution in Harvesting Machines	51
Professional Viewpoints	52
Men of Machines	54
Noteworthy Patents	58
Topics of the Month	62
How Is Business?	66
New Materials and Parts	68
Manufacturers Publications	84
Business and Sales Briefs	86

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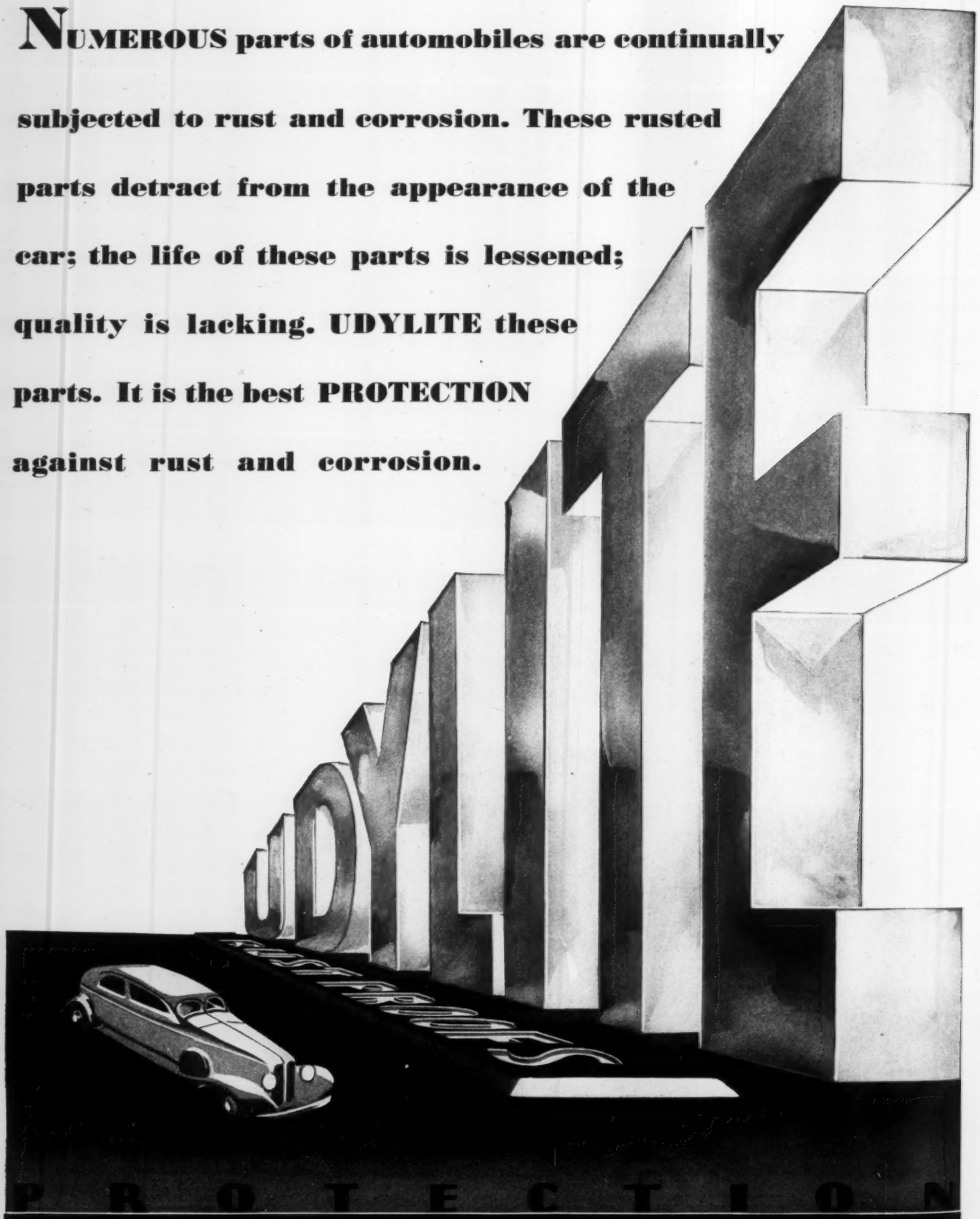

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Itemized Index for May, 1931

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

Design Calculations:
Roller Friction Clutch, Edit. 48, 49 L

Design Problems:
Conserving Floor Space, Edit. 26 R, 27
Considering Finishes from Sales Standpoint, Edit. 41, 42
Controlling Revolving Masses, Edit. 29, 30, 31, 32
Creating Conditions Favorable to Ideas, Edit. 62 L
Devising Means for Rotating Pipe, Edit. 43, 44, 45
Employing Compressed Air, Edit. 33, 34, 35, 36
Obviating Shock, Edit. 33
Reducing Casting Difficulties, Edit. 37, 38, 39, 40
Studying Sales Suggestions, Edit. 53 R

Finishes:
Machine Finishes from Sales Standpoint, Edit. 41, 42
Rust-Proofing, Edit. 74 R; Adv. 6

Materials:
Alloys (Iron), Adv. 17
Alloys (Nickel), Edit. 31 L; Adv. 63
Alloys (Steel), Adv. 14
Cork, Adv. 85
Composition, Adv. 88 L
Zinc, Adv. 91

Mechanisms:
Adjusting, Edit. 58, 60 L
Free-Wheeling, Edit. 48, 49 L
Pipe Rotating, Edit. 43, 44, 45
Rotor Hub, Edit. 29, 30, 31, 32
Starter, Edit. 32

Organization and Equipment:
Of Engineering Department, Edit. 23, 24, 25, 46, 47, 49, 52 R, 53, 64 L; Adv. 16, 21

Parts:
Back Stop, Edit. 68 L
Bearings, Edit. 31 L, 60, 68, 70 L; Adv. 2, 4, 12, 15, 57, 69, 73, 80 L, 83, 87, 89
Brakes, Edit, 28 R, 32 R
Cast Parts, Edit. 37, 38, 39, 40
Clutches, Edit. 48, 49 L, 70 R
Contact Points, Adv. 76 L
Controls (Electrical), Edit. 70 R, 72 L; Adv. 8, 9, 90
Couplings, Edit. 72; Adv. 88 L
Cylinder-Piston Units (Air), Edit. 33, 34, 35, 36
Drives, Edit. 26, 43, 44, 45, 58 L, 72 R, 74; Adv. 3, 10, 11, 13, 19, 67, 71, 77, 78 L, 82 L
Electronic Equipment, Edit. 27 R, 28 L
Fastenings, Adv. 81
Forgings, Edit. 31
Gears and Gear Blanks, Adv. 19, 79
Lubricating Equipment, Edit. 31 R
Motor Bases, Edit. 78 R
Motors, Edit. 35, 36, 74 R, 76 R; Adv. 20, 22, 61, 75
Packing Glands and Packing, Edit. 78 R; Adv. 59, 86 L
Pumps, Edit. 80 R, 82 R
Rotor Hub, Edit. 31, 32, 33, 34
Springs, Edit. 64
Stampings, Adv. 65
Welded Parts, Edit. 82 R; Adv. 18, 79, 92

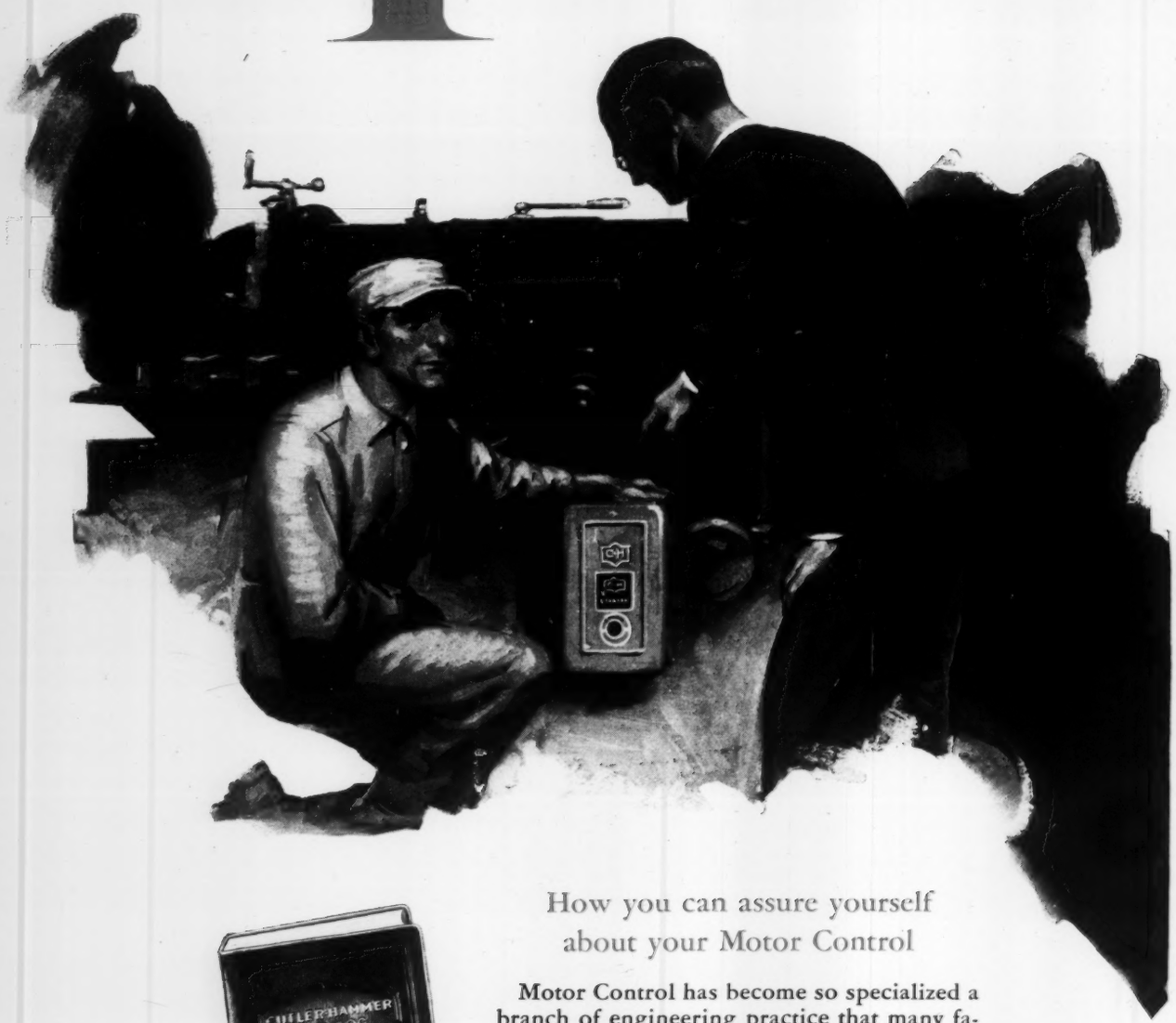
Principles:
Centrifugal, Edit. 30
Pneumatic, Edit. 33, 34, 35, 36

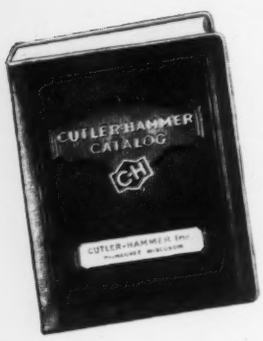
Standardization:
Standards Yearbook, Edit. 64 R

THE pace of progress never was swifter than it is today. Almost daily something new emanates from research in mechanical, electrical, metallurgical or chemical engineering, which means new materials, new methods or new parts for the use of engineers responsible for design.

One of the primary functions of Machine Design is to watch these developments and to advise its readers promptly of every new discovery which will in any way affect design.

No PROSPECT





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MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
May, 1931 Vol. 3—No. 5

Shall We Revise Our Conceptions of Engineering Functions?

By L. E. Jermy
Managing Editor, Machine Design

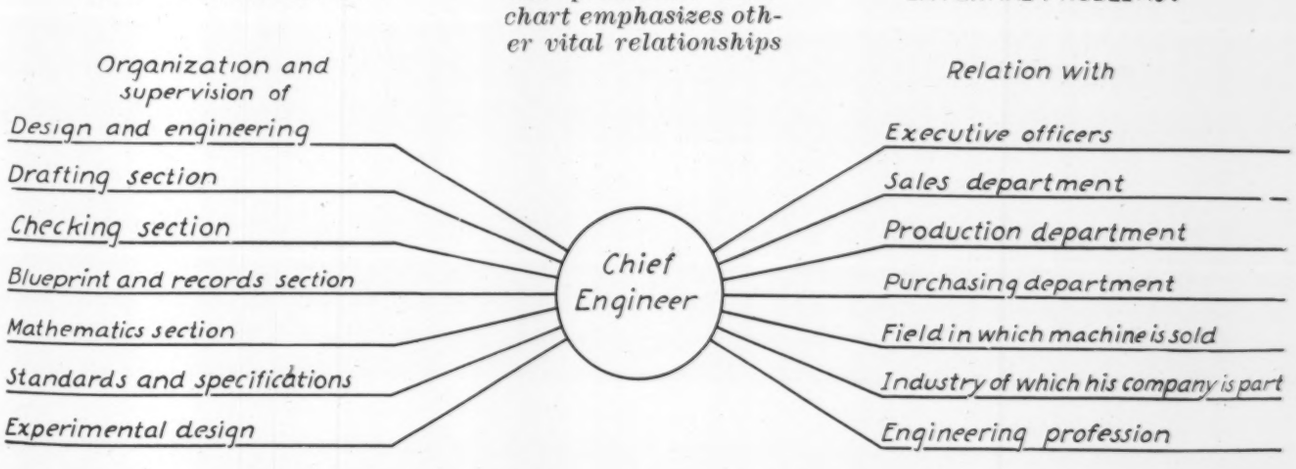
ASCENDANCY of the machine has done more to place engineers under the spotlight of public scrutiny than anything that has transpired in the long history of scientific development. The engineering profession stands before a critical world as the creator of a machine age which, while conferring unlimited benefits upon civilization, also has introduced numerous difficult new problems.

Elliot Dunlap Smith, in an address at the last annual meeting of the American Society of Mechanical Engineers, aptly described the present plight of engineering when he said, "No other profession has gone so far in the attainment of its goal, and none has ever been so roundly abused for its success in doing this."

The engineer is definitely on the defensive, which fact may prove to be a blessing in disguise because it is forcing leading members of the profession to think more clearly on the duty of engineering to mankind. During the past few months a score or more of eminent engineers have expressed the belief that the engineering function embraces not only the creation of machines but also the responsibility for seeing that they are installed in the industrial and social life of the world without undue shock.

Dr. Albert Einstein voiced this thought during his recent visit to America when he gave this advice to a group of engineering students: "It is not enough that you should understand about

No longer should chief engineers consider only their internal problems. This chart emphasizes other vital relationships



applied science in order that your work may increase man's blessings. Concern for man himself and his fate must always form the chief interest of all technical endeavors. . . ."

It is significant that in practically every statement that is made regarding the necessity of recognizing the human element, there is an implication that many engineers are too prone to confine their activities to technological problems. Progressive engineers are now wondering if the profession has not lost many opportunities through its penchant for dealing with material factors more than with human relationships.

This trend of thought is but one of several manifestations of impending changes in our conception of the scope of engineering. The idea that the functions of an engineer should be broader is not new, but the insistence that something be done about it has been crystallizing more definitely in the past year than ever before.

While an imposing number of prominent members of the profession have gone on record as favoring a more liberal interpretation of the duties of the engineer, not one of them has volunteered suggestions as to how these desired changes may be accomplished. It is one thing to inculcate in engineers the desire to extend the horizon of their activities and quite a different matter to help them to apply the idea to their work.

It would seem that the best approach to the problem is through a study of the engineer's place in industry. What are his present duties and responsibilities? Are certain phases of his work being over-emphasized to the extent of neglecting opportunities in other directions? Just what is expected of an engineer?

These appear to be simple questions, but in attempting to answer them one quickly arrives at the conclusion that the engineering profession is singularly lacking in information on the true functions of engineers. Libraries, technical schools and other sources afford ample instruction on strength of materials, mechanics, dynamics, design, construction and other information which the engineer employs in his work, but they provide practically nothing of value as to how he shall apply this knowledge.

Even the definitions of engineering itself are vague. Here is a typical dictionary definition: "Engineering is the science and art of making, building or using engines and machines, or of designing and constructing public works or the like requiring special knowledge of materials, machinery and the laws of mechanics."

If the average engineering graduate accepts this definition literally, is it any wonder that his vision of the boundaries of his life work is limited?

The American Engineering council improved on this conception of engineering when it adopted the following: "Engineering is the science of controlling the forces, and of utilizing the materials of nature for the benefit of man, and the art of organizing the human activities in connection therewith."

Here in this definition of comparatively recent origin we find the first important recognition that problems of organization and management are proper functions of engineering. And yet, even a casual canvass of the activities of engineers will show that the majority of them still consider "the controlling of forces and utilizing of materials" as the principal functions of their jobs.

We can illustrate this point by analyzing the duties and opportunities of a chief engineer in a manufacturing company. His problems can be divided into two simple classifications—internal and external—as shown in the chart at the bottom of the preceding page.

The internal problems are those relating to the routine operation of his own department. They include the familiar problems of design and the execution of conventional engineering work, supervision of the sections devoted to drafting, checking, preparation and filing of blueprints and records, maintenance of adequate standards and specifications, provision of the required mathematical services, conduct of suitable experimental work, handling of patents and also the supervision of many other items.

These internal problems constitute the "bricklaying" part of the chief engineer's work. They represent the minimum essentials of the job. They are fundamental.

Unfortunately there are many chief engineers who look upon these fundamentals as the sum-total of their responsibilities. To them exposure to relationships beyond the limits of the engi-

CHANGES in the conception of the functions of engineering are not new to readers of MACHINE DESIGN. The series of articles on "Organization and Supervision of Design Department," which appeared in issues of 1929 and 1930, and numerous discussions on the responsibilities of engineers in considering the human element, published during the past year, have served to give readers of this publication a clearer perspective of their work.

The accompanying article is introductory to a series to appear in subsequent issues dealing with the co-operation of engineers with individuals, groups and fields outside of their own departments. It will constitute the first comprehensive study of the external problems of engineers responsible for design.

—The Editors.

neering department is distasteful—an evil to be avoided as much as possible.

That this feeling of detachment really exists is not surprising. Engineering literature contains little in the way of instruction or inspiration which would tempt the engineer to explore fields beyond the door of his own bailiwick. The conventional organization charts of the manufacturing industries seldom show the chief engineer in a position of close relationship with other departments. Fortunately, however, the more progressive engineers have discovered the latent opportunities which lie in outside contacts. Thousands of them recognize the value of working closely with other departments and of keeping in touch with activities outside of their own company. But something should be done to impress upon graduate engineers and upon younger members of the profession the desirability of cultivating outside relationships as assiduously as they devote attention to the internal problems. This is a task of education to which engineering schools, engineering societies and management should bend their best efforts.

The external problems of the chief engineer call for qualifications which seldom are brought out in the internal routine of an engineering department. Essentially they are problems of dealing with personalities rather than with materials and forces. They involve relations with the president and other executive officers of the company, with the sales manager, works manager, purchasing agent and in large companies with many other individuals. They also include close contacts with the field in which the company's machine is sold. This may embrace familiarity with customers of his own company and those of his company's competitors.

Another important external problem involves the chief engineer's familiarity with the industry with which his company is identified. Unless he knows what is going on in his own industry, he is seriously handicapped in handling even the fundamentals of his position.

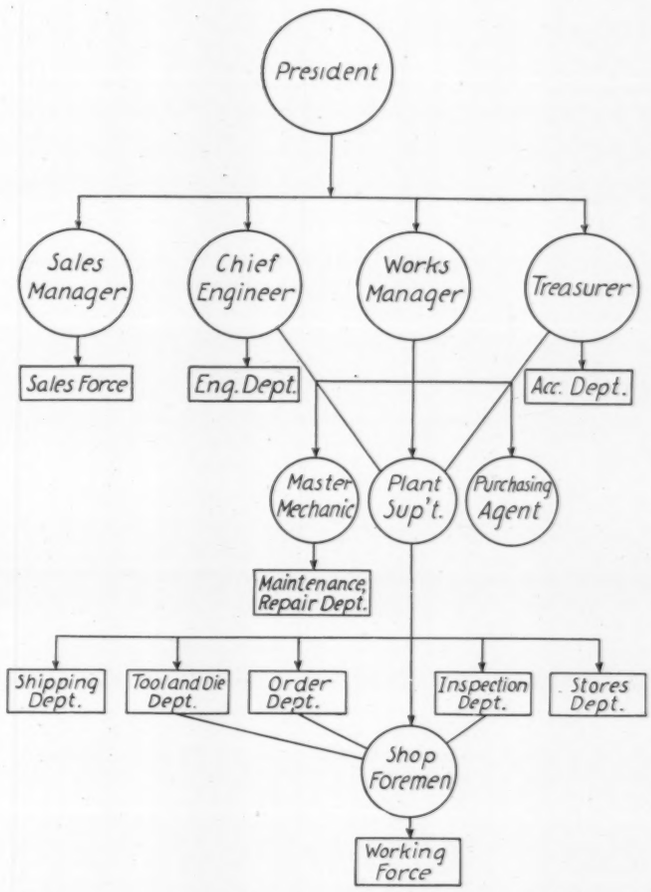
It should hardly be necessary to state that an engineer owes it to himself to be active in the councils of his own profession, but emphasis of this point is necessary because of the number of engineers who overlook the opportunities in this direction. Participation in the affairs of one's engineering society is important because it acts as a stimulant which cannot be obtained in any other manner.

The hope of the engineering profession in meeting the new challenge of the world lies in its ability to solve the foregoing external problems. The possibilities in the internal problems have not been exhausted, but the fundamentals have been reduced to routine and as such are under sound control. Therefore, from now on the greater measure of emphasis must be placed on external relations.

If it is true—as so many of our leading engineers have stated—that engineering in the future must concern itself not only with the creation of machines but also with the effect of these machines on society, then it is all the more necessary that more attention be given to external problems. Solution of the difficulties created by the machine age never will be accomplished by engineers whose vision does not extend beyond the walls of the engineering department.

If it is true—as many eminent authorities contend—that the majority of engineers are not sufficiently interested in the commercial possibilities of their creations, then that too is another important reason why greater emphasis should be placed on outside interests. An engineer who devotes his time exclusively to internal routine cannot possibly get the "feel" of consumer buying habits, which is so essential in successful manufacturing today.

Cultivation of broader viewpoints through closer attention to external problems is essential to success in engineering. In future issues, MACHINE DESIGN will present articles showing how progressive engineers meet this challenge.



Conventional organization chart in which chief engineers' relationships are incorrectly shown

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

PROGRESS in the design of machinery is indicative of the more extensive transference of ideas from one field to another. An outstanding example of this is a mooring mast for the navy dirigible, AKRON. Motorization of the mast so that it can be moved about under its own power will save much time and human energy in handling the large ship which is under construction at the Goodyear hangar. As shown in Fig. 1, the automobile and the crawler tractor have contributed ideas which will enable this 200-ton mast to be operated by one man. It is estimated that no more than six attendants will be required to moor a dirigible. This is particularly significant since heretofor it has been necessary to have a group of soldiers or sailors at the airport to assist in the landing.

Built like a tripod, each leg rests on crawler treads. Power is transmitted to two of these through a differential such as used in an automobile. The third treaded wheel serves as a steering member to guide the mast about the airport. Ground conditions will play a comparatively small part in determining where the unit can be driven, made possible by the crawlers which proved their efficiency on tanks during the war.

The fact that it is the first self-propelled mast ever constructed marks an advancement in portability in this type of equipment. The 225 horsepower engine housed in the center of the triangular base is coupled with a generator which produces electric current for the driving motor. This arrangement of driving electrically was incorporated so that the mast could be propelled smoothly over the ground.

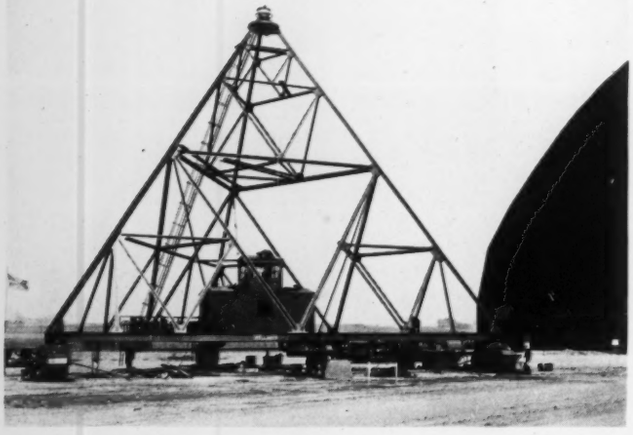


Fig. 1—Portability characterizes the mooring mast at the Goodyear Zeppelin hangar

To place the source of power at the point where it is to be applied, the driving motor was underhung from the base in line with the drive shafts. Another electric motor is used in connection with the steering mechanism, thus enabling the operator to guide the structure without having to apply sheer strength. A winch installed on the base will be employed to draw the ship's nose into the cup at the tip of the mast by means of a line dropped by the air crew. The mast was built by Wellman Engineering Co., Cleveland.

The motorized feature of the mast combined with the leaf-like construction of the hangar doors will enable the dirigible to be held to its mooring while being taken either in or out of port. Fig. 2 shows the open end of the hangar through which the mast will serve the dirigible. The unique drive and control of the two 600-ton doors were described in the November, 1929, issue of MACHINE DESIGN.

Vertical Unit Saves Floor Space

WHEN floor space becomes a scarcity the logical thing to do is build vertically and utilize height to accomplish what cannot be done horizontally. This was the idea that produced a vertical parking machine for automobiles. In carrying out the plan the principle of the unattended elevator was employed. Ground space with an area little greater than that required by a double garage accommodates the machine, which houses 24 automobiles. It was developed by H. D. James, Westinghouse consulting engineer.

Not only does it conserve space but it provides automatic control. Push a button, turn a key or deposit a coin and a parking place is ready in less than a minute. Upon the driver's return the car automatically is delivered. Cutaway front view of the first parking machine perfected is shown in Fig. 3. This consists of cradles,

one for each car, supported by two endless chains which pass over sprocket wheels at the top and bottom of travel.

Two electric motors are employed to drive the chain. Three general methods of control, all of which are substantially the same, may be used for operating the parking machine. Key systems usually are used where the garage is rented for a fixed time but in public garages the push-button system is popular. In the latter instance the driver after he has parked his car operates a lever to obtain a check stamped with the location of the car and the time of parking. This lever also establishes a circuit for closing the doors and sets up a circuit for dispatching an empty cage to the driveway level for the next automobile.

When the driver returns for the car he presents his check to a cashier who pushes a button corresponding to the number of the check. The doors open automatically and the cradle containing his car is lowered to the driveway level ready for him to drive out. In driving off

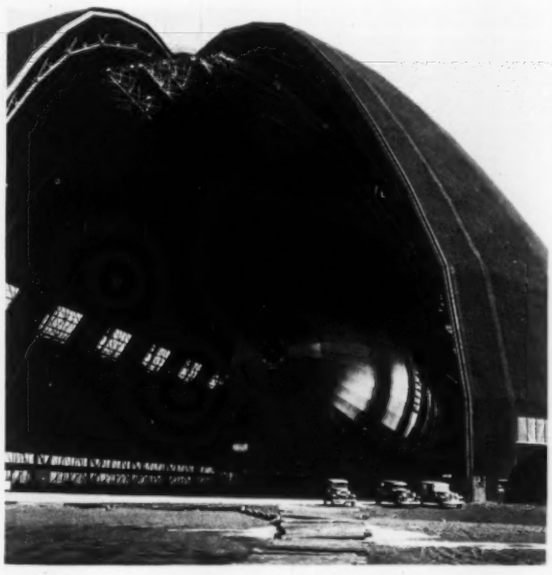


Fig. 2—Motorization of the mooring mast will enable it to serve the dirigible through the open doors of the hangar

the cradle a circuit is established for closing the doors. Practically the same operations take place when a coin deposit is used, except that it eliminates the cashier.

Present design of the machine permits a chain speed of 100 feet per minute, so that the average time for bringing a cage to the driveway level is 30 seconds. When the cage is called to the driveway level the machine automatically selects the shortest route. The elevating system can be operated only when the door is closed. Inside the enclosure at the driveway level are two platforms, one on each side of the cradle. Persons entering or leaving the automobile must stand on one of them, thus opening a contact which prevents the doors being closed as

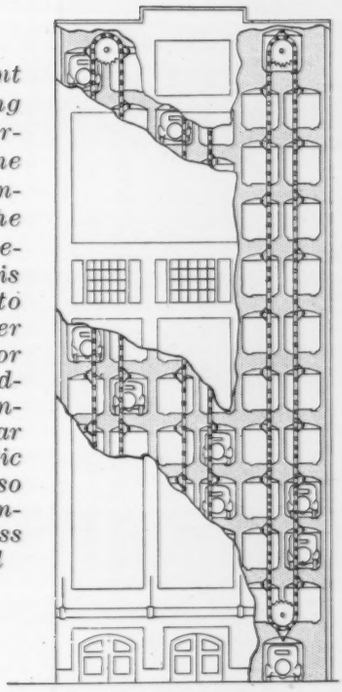


Fig. 3—Cutaway front view of vertical parking machine showing tiering of automobiles, one above the other. Conservation of space is the fundamental idea behind the design of this unit which is adapted to be controlled by either a key, push-button or coin deposit. Two endless chains are employed to carry the car cradles, and automatic means are provided so that the machine cannot be operated unless the doors are closed

long as anyone is within the enclosure. Looking through the open doors in Fig. 4, a car can be seen in one of the cradles.

In laying out this machine the designer also had in mind its use as a freight elevator, making it possible to unload at the top as well as the bottom of the loop. It also may be used to display automobiles, thereby conserving unlimited space in a showroom. Commodity storage or container service for truck delivery offers another application.

Some of the same ideas which have been incorporated in the vertical parking machine are found in a book conveyor built by the Standard Conveyor Co. for the Aetna Life Insurance building in Hartford. This unit is built up through eight stories and has a capacity for handling 56,000 parcels a day. The carriers travel on an endless chain which runs over sprockets at the top and bottom of the elevator. Below each sprocket is a disk provided with notches which connect with a pin at the bottom of each carrier to maintain the carriers in vertical position when traveling around the upper or lower sprocket. The unit is interlocked electrically so that a certain package can be directed to any particular floor.

Vacuum Tubes Simplify Design

TELEVISION is opening a new field of technical possibilities and rapidly is being developed for the market. By following its experimental course, interesting ideas which might be applied in other fields, can be found. For example, one of the problems of television has been the elimination of moving mechanical parts, particularly the whirling scanning disk

and its associated motor. Before television can become practical in the home the mechanism must be simplified and made practically foolproof.

By utilizing a cathode ray tube, both Vladmir Zworykin, Westinghouse research expert, and

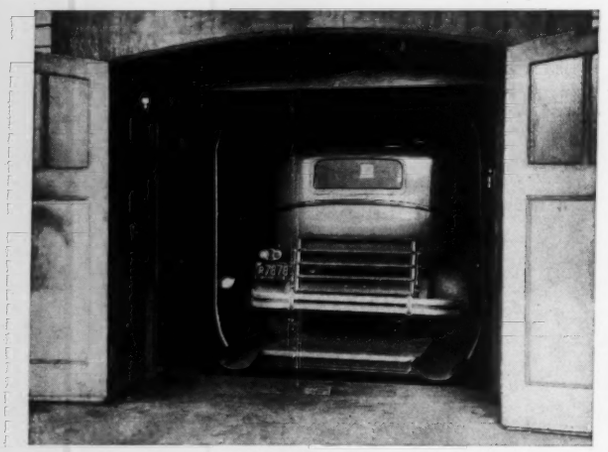


Fig. 4—One of the cradles by which a car is elevated in vertical parking machine

Philo T. Farnsworth of California have designed sets which eliminate the spiral disk and associated moving parts. Just a few days ago an announcement was made that Hollis S. Baird, chief engineer of the Shortwave and Television Corp., Boston, had developed a neon lamp, optically amplified, television system. Laws of optics which have found only primary applications in experimental television to date are utilized fully in his machine. Synchronization is made automatic by the use of a phonic motor and amplifier.

Another attainment through the more extensive application of electronic apparatus, is the adoption of the grid-glow tube in connection with new safety measures in the airplane industry. This tube and five robots are used to warn pilots of a dangerous condition of wing structure. Four robots on the wing tips and one in the cockpit are adjusted to light the tube when the difference between the shock on the wings and on the cockpit exceeds a certain limit.

Further application of vacuum tubes is shown by the recent installation of the thyratron tube instead of mechanical contactors in control equipment for intermittent line and spot welding. The innovation was announced by General Electric Co. and is shown hooked up with welding equipment in Fig. 5.

What Do Rocket Motors Signify?

RADICAL departure from the conventional always is viewed more or less pessimistically but it cannot be ignored entirely when it involves design of machinery. Such is the case with the production of a motor weighing only 14 pounds, but capable of developing 200 horsepower. This unit was designed by Paul Heyland, German expert on liquid gases, according to advices from Berlin. If this is successful and practical it undoubtedly would revolutionize engine design.

By improving the rocket motor propelled last year by recoil produced by igniting liquid air mixed with gasoline, and enlarging it, the inventor believes he will attain a record in long distance airplane flying. He expects to be able to demonstrate by the middle of the year, that a continuous stream of propulsive energy can be created by his invention which is superior to powder rockets where power is sporadic.

New Trend Affects Brake Design

INCREASED employment of free wheeling devices has created a need for safer and better braking power in automobiles. Consequently new ideas in brake design are particularly pertinent at this time. The situation is complicated still further by the growing tendency toward smaller diameters in wheels. Use of disks in order that more space can be provided for the brake drum seems to be the logical construction. In this connection, word comes from Detroit that several of the well known companies in the industry are working on these lines. Along with a solution to the brake problem, construction to provide wider rear seats is being sought.

Free wheeling and high traveling speeds also has made the question of the best material for brake construction of increasing importance.

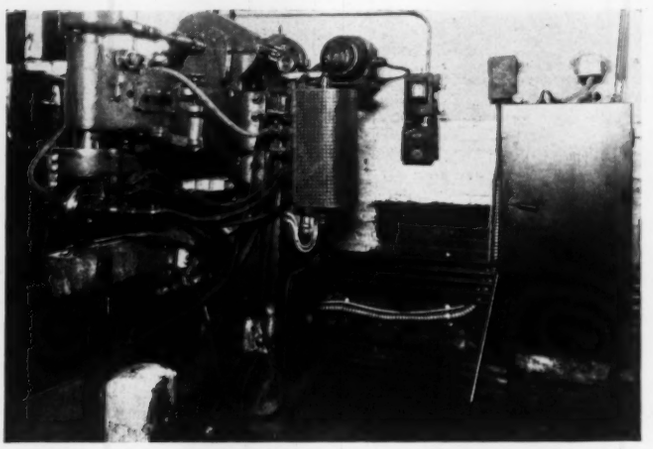


Fig. 5—Thyratron tubes are used in the control of this welding machine

Cadillac has gone to a cast iron drum. Stainless steel, it is claimed, provides the best lining with as high as a 300 per cent longer life, so stainless veneered steel for brake drums may be the outcome. Motor manufacturers want a high carbon steel but one to be worked cold for drum construction. This, however, has been pointed out by informed interests as an impossibility.

The Heart of the Autogiro—the Rotor Hub

By Joseph S. Pecker

IN ADDITION to the many problems in aerodynamics involved in the successful design of the Autogiro, several mechanical problems present themselves which require unique and novel arrangements to meet the rigid specifications of safety, reduced parasite resistance and low weight. The most complex of these problems are the rotor hub system, the mechanical starter by which the rotor blades can be brought up to speed to make possible a takeoff with an amazingly short run, and a brake by which the revolving blades can be brought to a stop when the Autogiro descends.

To understand fully the design problems involved in the development of the above three units a brief description of the flight and construction principles of the Autogiro is deemed desirable. In outward appearance the machine is similar to a low wing monoplane with these exceptions: (1) The wings are short with sharp upturned tips and are not cambered, and only support a maximum of 20 per cent of load at high speeds; (2) the undercarriage is much wider; and (3) a pylon or tripod structure consisting of three tubes converging into an apex, rises vertically above the fuselage, the apex of the pylon supporting the vertical axle on which the rotor system revolves.

The rotor system is the essential characteristic of the Autogiro and gives it its name. The hub of the rotor system becomes the housing for the radial and thrust ball bearings on which the entire system rotates. Extending from this hub are four universal joints of a special construction, used to attach the blades to the hub. This method of attachment enables the blades to balance themselves in proportion to the lift forces imposed on them.

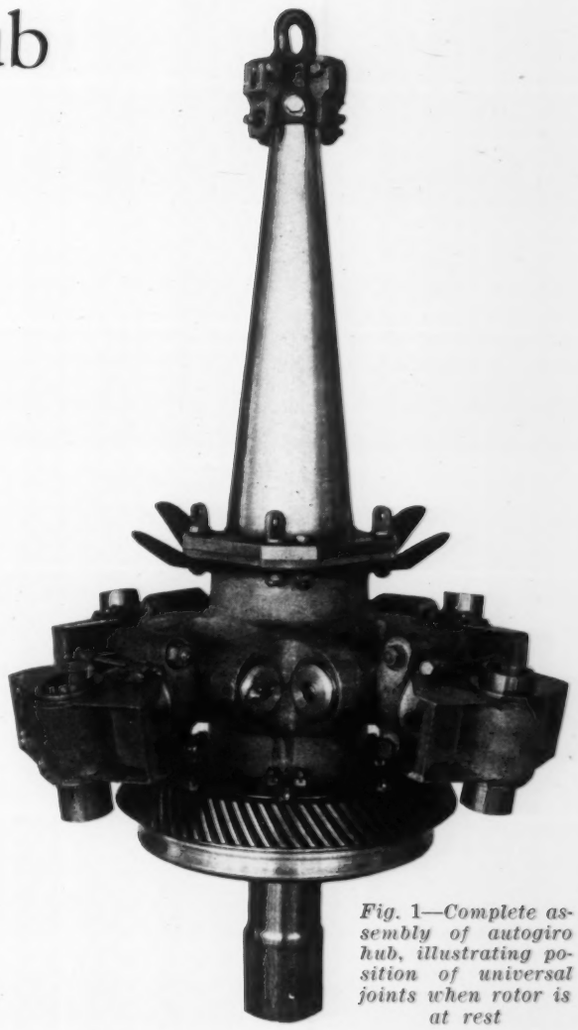


Fig. 1—Complete assembly of autogiro hub, illustrating position of universal joints when rotor is at rest

Balancing of the blades is significant, for while in straight vertical descent the airspeed encountered on all blades is equal, in forward flight this equality is eliminated by a differential of the forward speed which is added to the velocity of the advancing blade and subtracted from the receding. Unless some means were taken to overcome the inequality of lift caused by this difference of airspeed, the machine would tip in relation to the line of flight and its stability would be lost. The simple and ingenious scheme of hinging the blades to the rotating shaft so that they are free to yield up and down, balances the dissymmetry of lift on diametrically opposed blades and results in complete sta-

PARTICULARLY timely interest is attached to the accompanying article on account of the recent landing of an Autogiro on the White House Lawn, and other activities surrounding the new type craft. The author is consulting engineer and at present is acting in the capacity of chief engineer with the Autogiro Specialties Co.

bility. The advancing blade rises automatically, decreasing its effective angle of incidence, while the receding blade descends automatically thus increasing its effective angle of incidence. This balancing of the blades also eliminates all of the abnormal cantilever loads which would develop in the hub structure if the blades were made rigid with the hub.

When the Autogiro is in flight the rotating blades are subjected to two major and opposed loads brought about by natural forces. Under the action of lift the blades have a tendency to rise, since they are free to move about the hinge at the root. This tendency to rise is overcome by the centrifugal force of rotation acting at right angles to the lift force. The equilibrium of the two forces results in the rotor system coning slightly in flight.

Rotating Wings Develop Lift

In comparison with the conventional airplane, the Autogiro differs in its performance as follows: (1) Bringing the blades up to speed with a mechanical starter is equivalent to the plane racing across the field to develop lift in takeoff. (2) In flight the rotating wings develop 80 per cent of the lift. The plane can be brought almost to a sudden stop by maneuver of the stick or throttling of the engine. The ship will not stall but gradually will lose altitude. (3) In order to land, the Autogiro can hover and the vertical air thrust through the blades will keep the blades in rotation and thus sustain it in a slow vertical landing with virtually no forward speed. The engine is throttled to develop zero forward thrust.

Vertical rise is not possible with the Autogiro. The rise is at a steep angle which is a component of the vertical lift of the blades from their initial speed developed by the mechanical starter and the horizontal thrust of the propeller. Takeoff follows almost immediately on the release of the landing wheel brakes. Contrary to popular conception, the rotating blades in flight are not driven by the engine. Immediately after bringing the rotor blades up to speed (before takeoff), the mechanical starting device is disengaged and thereafter the blades revolve freely on a vertical axis. In flight, if the motor should stop, the blades will continue revolving.

Rotor Hub Loads Are High

Several factors control the hub design. In the first place there is the need for reduced weight to keep the center of gravity as low as possible. There also is the requirement for simplicity of design for economy in production, assembly and service. Finally, it is necessary to withstand the multiplicity of stresses imposed on the hub lugs by centrifugal and torsional forces of the blade; to withstand the variable moments set up by the shifting of the vertical thrust, as well as the torques developed from the mechanical starter and the brake.

Assuming a ship weighing 3000 pounds, the weight of the blade would be about 75 pounds and diameter of the blade disk about 45 feet. Therefore, the centrifugal force developed on the hub and on each one of the articulation points would amount to approximately 13,000 pounds, when the hub revolves at high speed. Added to this, there is a torque developed by the incidence of the blade amounting to 700 foot pounds. As one of the principles of the Autogiro is that the blades are free to assume any angle proportional to the load that may be imposed on them the vertical thrust component will shift from the direct center of suspension to some distance between the horizontal articulation and the true center of thrust. This develops high bending moments about the vertical axle, on the ball bearings and on the horizontal lugs of the hub. The torque developed on the lugs from starting the rotor blade mass from rest by

Fig. 2 — Recent models flying over the still uncompleted Hudson River bridge, New York. A striking example of two types of suspension practically applied by the engineer

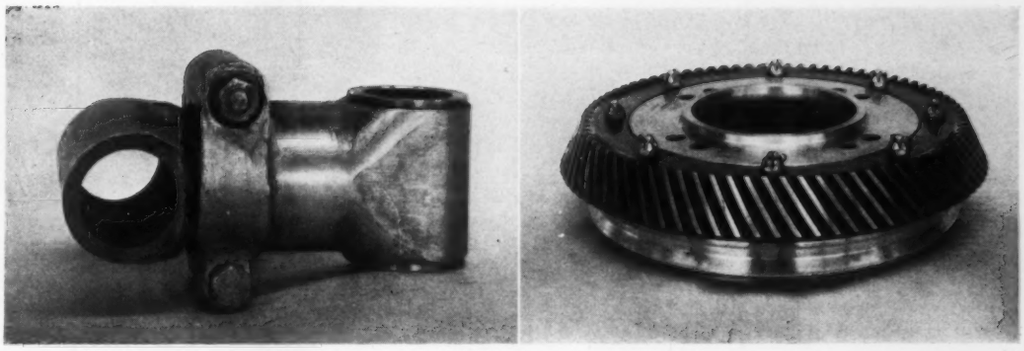


Fig. 3—(Extreme right)—Ring gear for the starter drive. (Adjacent)—Universal link of rotor blade, between horizontal and vertical articulation

the mechanical starter is about 2000 foot pounds. To keep the rotor blades in motion against the air drag requires about 40 horsepower. The centrifugal forces developed by the blades imposes a pressure of 7000 pounds per square inch on the universal bearings.

Construction of Rotor Hub

The hub is similar to the hub structure of an automobile front wheel, being a hollow unit forming a ball bearing housing. There are three ball bearings employed on the vertical axis. The topmost takes all the thrust in flight and the second and third take only radial load, with the exception that the lowest bearing takes the combined radial and thrust load of the rotor system when revolving on the ground. As the gross weight of rotor hub, articulation joints and blades is approximately 350 pounds, it will be obvious that the thrust load on the lower bearing is negligible. Although ball bearings thus far have been used exclusively, and very successfully, tapered roller bearings could be employed with equal success. There are eight horizontally disposed lugs, each two lugs representing the horizontal articulation for one of the universal joints to which the blades are fastened. The blades, of course, are disposed at ninety degrees to each other.

An examination of the rotor hub unit discloses a flange above and below the horizontal lugs. To the top flange is bolted a cone-like structure and at the apex of this cone is a crossed member to which are attached diagonal cables fastened approximately midway of the blade in order to suspend the blade in a horizontal position. Fastened to the lower flange is the brake drum, the latter having a concentric flange at the periphery on which is mounted a spiral bevel gear which is part of the mechanical drive of the blades.

Chrome nickel alloy steel, oil hardened, is used for the hub forging. Particular care is taken to assure that the grain structure approximates the direction of the loads that are imposed through the lugs, ball bearings and flanges. The forgings are first normalized, quenched and drawn, rough machined, then heat treated and drawn to the proper Rockwell or brinel hardness scale, carefully tested and inspected and finally finish machined. The hub is machined all over in a series of drilling, boring and milling fixtures to insure accuracy of assembly and interchangeability of parts. All tool marks, scratches, etc. are polished clean and the exposed surfaces are cadmium plated.

The articulation joints or universal joints are next in importance. Extending from the horizontal bearing on the hub is a center block or spacer that determines the distance between the horizontal and the vertical articulations. This extension piece is made in two parts and their attachment to each other affords the required adjustment necessary to change the incidence of each blade.

By a careful choice of material and heat treatment, all of the universal parts are reasonably light, yet are capable of withstanding the combined tensile, bending, torsional and shear loads imposed on them. An interesting development of the universal joint was the proper selection of bronze and lubricant. It is obvious that for compactness and reduced weight, bronze bushings were the ultimate alternative. The bushing has to withstand a pressure of approximately 7000 pounds per square inch because of centrifugal and torsional loads developed by the blade.

Lubricating the Hub Bearings

Selection of a grease for lubrication as against oil was based on several definite reasons. Oil will leak, both in flight and when at rest. Sealing the articulation bearings or reclaiming the oil would prove too intricate an installation. The use of oil in the ball bearing system would involve a circulating pump to keep the upper ball bearing supplied constantly, as the upper bearing is the one most severely stressed. The servicing of the hub and parts would require careful draining of all oil, before any part of the hub could be disassembled. Grease eliminated all of these vexing problems.

Starting the rotor blades before takeoff was an interesting problem. In the early designs of the Autogiro it was necessary to taxi around the field to bring the rotor up to sufficient speed to give an effective lift. This maneuver was far

from simple and taxed the patience of the pilot. The next innovation was the introduction of a large elevator or tail that could be tilted to deflect the slip stream of the propeller upwards and thus start the rotor. This system was fairly effective and is being used today in the construction of English built Autogiros. The mechanical starter is distinctly an American development and its introduction marks one of the most fundamental innovations in the progressive developments of the Autogiro since is was brought to

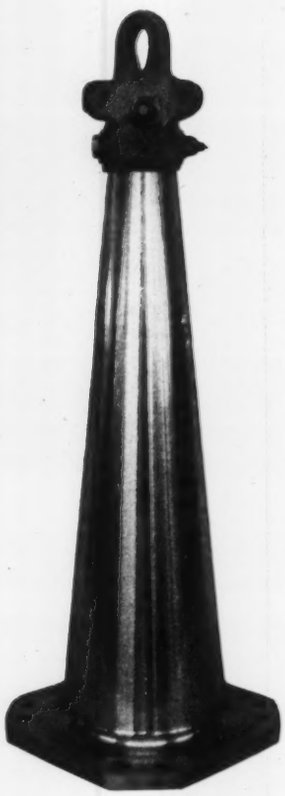


Fig. 4—(Above)—Main forging of rotor hub. (Right)—Cone-like structure from which blades are suspended

America by Harold F. Pitcairn.

The requirements of a mechanical starter were as follows:

(1) It must be compact and light in weight.

(2) On a 3000 pound ship with four 75-pound blades, it had to transmit 40 horsepower to start and keep the blade rotating at 125 revolutions per minute.

(3) A flexible torque shaft had to be provided to compensate for the flexing in structure between the engine mount and the apex of the tripod on which the hub is mounted.

(4) A friction clutch had to be provided that would permit a yielding pickup as the static inertia of rotor blades gained in momentum.

(5) Proper gear reduction to reduce the engine speed of 1400 to 1600 revolutions per minute to the required speed of the rotor blade of 125 revolutions per minute.

(6) It was necessary to provide an overrunning device that would permit the blade to run ahead of the driving shaft if the engine missed fire and slowed up or if a gust of wind should speed up the rotor blade to a higher speed than it was being driven.

(7) The starter had to take power from the engine and had to fit on the standard flange usually provided for engine starters.

All of the above conditions were met successfully in the introduction of the first model. The starter comprises three units. The lower unit, consisting of a set of spiral bevel gears and a single disk clutch, is mounted on the rear face of the engine. A complementary flange is provided and the motor starter functions through a horizontally disposed shaft on the starter.

The second unit is a tubular torque shaft attached to the lower unit by a universal joint and rising obliquely to the apex of the pylon structure. The apex of the pylon or tripod is a box on which is mounted another device, the over-running clutch, to which the torque shaft is fastened by another universal. The torque shaft between the two universals is broken and a telescoping joint is provided to compensate for the flexible structure of fuselage and pylon.

The third unit is the overrunning device. On this is mounted a spiral bevel pinion. The latter meshes with a spiral bevel ring gear which is mounted on the rotor hub brake drum.

Design of the rotor brake was another problem that challenged in the first stages of development. The final solution was a two-shoe internal expanding brake of 8 inches diameter and 1½-inch face that will bring four 75-pound blades of 45 feet diameter, revolving 125 revolutions per minute, to a stop in 30 seconds.

The Autogiro with its ability to operate from small fields, its factors of stability and flexibility, remarkable nonstalling characteristics, ability of sustained flight at low speeds, wide speed range from 20 to 120 miles per hour and its simplicity of operation, opens new and vast markets hitherto untouched. It reaches farther than the present airplane market, and attracts a new airminded group.

Performing Mechanical Operations by Pneumatic Devices

By A. F. Clark
Editorial Representative, Machine Design

EMPLOYMENT of compressed air usually is associated with pneumatically operated hand tools, air chucks and other similar units. It has also, however, an important place as a means for actuating machine mechanisms. For many years it has been used in hoists of both the cylinder and rotary type, either alone or in conjunction with an intermediate fluid such as water or oil. Riveting machines and foundry molding machines utilize the pneumatic principle for creating pressure and for other purposes. An example of a more recent application of the simple cylinder and piston units is shown in Fig. 1 and utilization of a rotary unit is depicted in Fig. 7. These will be referred to in detail later.

Unlike many other forms of power transmission, the adaptability of compressed air was known hundreds of years before the Christian era. Evidences of its use are found in the writings of Heron of Alexandria, particularly in the description of the fire engine of the Egyptians. It also was used in early air guns and these, at least in toy form, have survived to the present day.

In machine operation, one of the chief assets of air under pressure is convenience, practically every plant in the country of any size being equipped with apparatus for producing it. Another asset is safety, particularly in industries where the fire hazard is high. Of importance also in considering the use of air operated devices, is that if the mechanism being controlled is hindered in its movement the air unit will stall whereas with a positive mechanical movement damage may ensue by breakage.

This characteristic has been found in the writer's experience to be helpful, particularly in feed mechanisms. In a sub-press designed with positive feed, continuous difficulty was experienced due to the jamming of the feed and consequent bending or breakage of the feed finger. The jamming was caused by nonuniformity of the parts being pierced. To overcome the trouble the sub-press was redesigned for a pneumatic feed, which proved also to be extremely rapid and accurate in operating performance.

Cushioning Effect Prevents Shocks

The cushioning effect obtainable with compressed air units also is advantageous, jarring and shock which otherwise might be troublesome being overcome readily. There are few, if any, forms of obtaining motion which could be claimed to be as flexible in control and as smooth in action.

Applications in which infinite speed control is essential present another opportunity for serious consideration of pneumatic units. By the simple operation of valve mechanism it is possible to

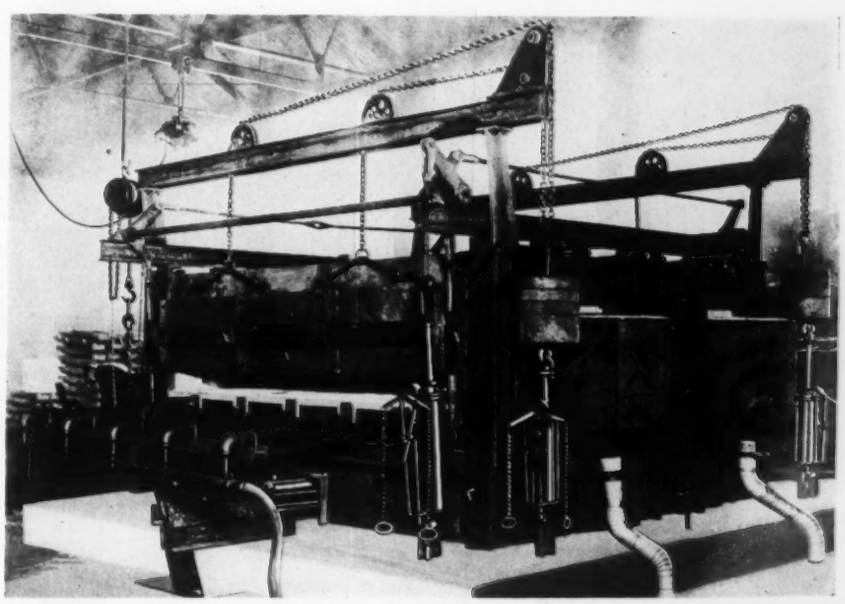


Fig. 1—Pneumatic cylinder-piston units are used to open and close furnace doors and to actuate feed pipes

obtain speeds varying from zero to maximum without difficulty.

For reasons indicated in the foregoing, the use of the pneumatic cylinder and piston unit, as shown in several of the accompanying illustrations, has been gaining favor for actuating machine parts within recent years. The design of the world's largest bottle machine, for instance, embodies a number of cylinder units. All movements of this machine, with the exception of the mechanism for operating the slide frame,

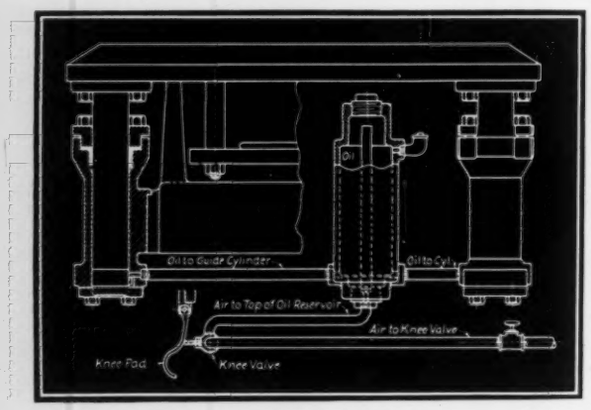


Fig. 2—Combination compressed air and oil cylinder mechanism employed to provide easily controllable and smooth feed

and the motor drive, are accomplished by means of air cylinders.

In the illustration of the annealing furnace shown in Fig. 1 are depicted three applications of air cylinders used for different purposes. The two cylinders at the right of the photograph are used for raising and lowering the furnace doors, and the other vertical cylinder raises and lowers the five pipes which serve as a table on which the work rests.

Two Cylinders Control Work

In operation the work is placed on these five pipes outside the furnace. The air cylinder then raises the pipes above the height of the furnace floor. In the center of the illustration, below the furnace, is shown a horizontal cylinder which pulls the pipes toward the furnace. The vertical cylinder then is operated again and the pipes are lowered, thus leaving the work resting on the floor of the furnace. Next the horizontal cylinder is reversed and the pipes assume their original position after which another batch of work is placed on the pipes and the operation repeated.

At the opposite end of the furnace the same equipment is utilized. The pipes at this end perform a similar function with the exception that the work is brought out of the furnace resting on the pipes, and as the latter are lowered the work which has been brought out of the furnace is removed.

Summing up the foregoing, the following cycle is performed by the one vertical and one horizontal air cylinder. The vertical cylinder lifts the pipes, the horizontal cylinder moves them horizontally. The vertical cylinder lowers the pipes and the horizontal cylinder moves them back to the original starting position.

All of the vertical cylinders used on the foregoing application are 6 inches in diameter and are of the balanced type. The horizontal cylinder is 8 inches diameter and is double acting. Operating valves are mounted in positions convenient to the operator.

Provides Accurate Movement

As mentioned previously, compressed air often is utilized in conjunction with other mediums such as oil or water. Indicative of an application of this nature is the table mechanism shown in Fig. 2, which illustrates combined oil

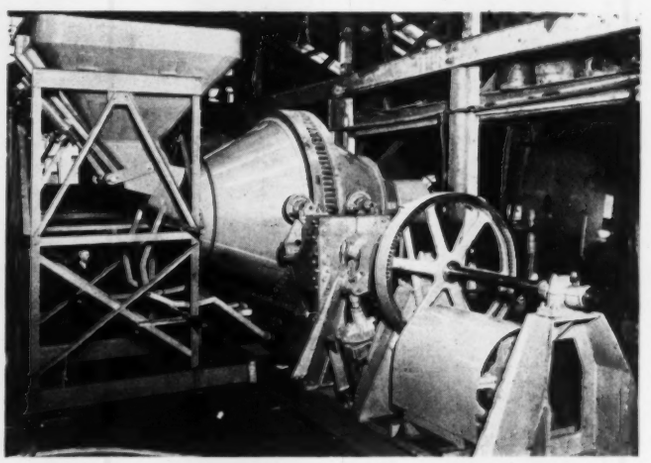


Fig. 3—Rotary motion is provided by the two air cylinder units used on the mammoth concrete mixing plant shown above

and air units. The oil is interposed to give a smooth and accurately controllable speed of piston movement with a relatively slow start upward and slow finish downward. An air cock in the supply line regulates the maximum speed and the unit is operated by the knee valve shown in the drawing.

While cylinder-piston units usually are employed for obtaining straight or reciprocating motion, Fig. 3 illustrates a concrete mixing plant in which the barrel is rotated through the desired angle by a pneumatic device. This may be seen at the right of the barrel. A lever arm is keyed to the shaft of the barrel and the air cylinder in this case is provided with a floating mounting to take care of the changing angle of the cylinder. At the left of the illustration is shown another cylinder unit, for opening and closing the hopper gate. By providing suitable leverage, the piston in such applications needs to

travel only a small amount to give ample movement to the gate.

In Fig. 4 is shown an interesting application of a pneumatic cylinder used to move the swinging jaw of a riveting machine. This jaw must swing into an open position in order that the work to be riveted may enter the machine in the riveting position. Thereafter the jaw must swing to its closed position so that its die will align with the mating die of the riveter. The jaw must be locked in this closed position so that the tonnage exerted between dies to drive the rivet will not cause the swinging jaw to move toward its open position; consequently a jaw or toggles are interposed between the cylinder unit and the swinging jaw. In the closed position of jaw these toggles are disposed in substantially a straight line.

The cylinder-piston unit holds the toggles against a stop when in the straight line position. While thus disposed the riveting tonnage of the machine aids the cylinder unit in urging the toggles against this stop since the toggles actually are moved slightly beyond the straight line position by this cylinder unit. In the open position the swinging jaw also strikes a stop; thus the parts moved by the piston provide the limits of movement in both directions. Consequently the swinging jaw also strikes shock or strain in the stopping movements and therefore may be relatively small.

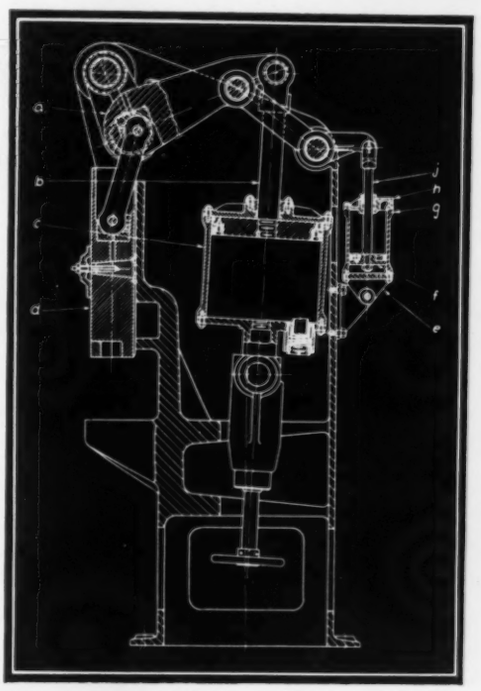
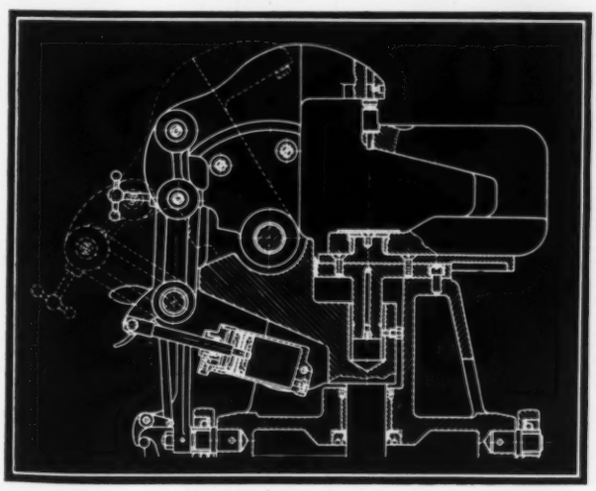


Fig. 4 (Below)—Swinging jaw of riveter is moved by a pneumatic unit. Fig. 5 (Right)—Employing a small auxiliary cylinder to counter-balance heavy parts



Two units are used in the 200-ton pneumatic press shown in Fig. 5, one for creating pressure and the other for counterbalancing the mechanism (particularly parts *a* and *b* which transmit the energy of cylinder *c* to ram *d*. The moving parts *f* and *j* of the counterbalancing cylinder-piston unit are relatively light and consequently are superior to a dead weight balance. Inertia moments which would be developed by the latter at the high speed at which this machine operates would make the application impractical.

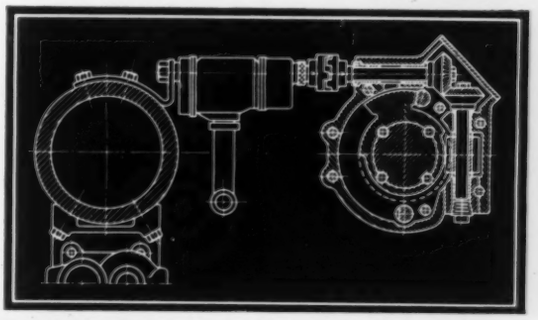


Fig. 6—Application of air motor for indexing the stake of riveting machine. These motors can be stalled without damage

For powerful clamping or gripping mechanisms the use of cylinder-piston units offers numerous advantages, particularly in that such mechanisms will hold the work with a predetermined power regardless of considerable variation which may exist in the size or shape of the work. This principle has been utilized in the design of a forging press or buildozer which forges the work gripped in the jaws. The piston of the air unit acts upon the rear ends of two jaw levers through the medium of rollers and jaw wedge blocks. The rollers are mounted side by side in the piston rod head, and are allowed a certain amount of clearance in the holes for the purpose of flexibility. The jaw levers each have trunnion bosses on both sides, these bosses being surrounded by link plates with elongation holes. The tendency of these jaws to move apart is resisted by the link plates through the medium of four crescent-shaped wearing blocks while the pin in the center of axis of the trunnion bosses serves to locate and align the jaw levers.

As mentioned previously, one of the advan-

tages of pneumatic units is that it is possible to stall them under severe overload conditions, in cases of jamming of machine parts, or where fouling or obstruction occurs, without damage to the operating parts. This characteristic is ex-

Horsepowers and Speeds of Air Motors at Various Pressures

Air Pressure Lbs. Sq. In.	Max. H.P. (B.H.P.)	Free Speed	R.P.M. at Max. H.P.	Cu. Ft. Air at Max. H.P.
	2.3	2500	1240	60
80	2.7	2300	1050	70
	3.1	2000	980	74
	4.7	1800	800	117
	2.7	2600	1260	70
90	3.0	2350	1100	75
	3.4	2100	1010	81
	5.2	1900	830	130
	3.0	2700	1280	78
100	3.3	2450	1140	82
	3.7	2150	1030	89
	5.6	1950	870	140

emplified in the mechanism shown in Fig. 6, which shows the utilization of an air motor for indexing the stake of a riveting machine. By means of this indexing movement the stake is located accurately at two positions of rotation and rotated between these positions. As will be seen from the illustration the air motor drives a worm through the medium of miter gears and a jaw coupling and the worm drives a worm gear mounted on the stake. On the worm gear is a lug which strikes two stop posts for limiting the rotation of the stake and locating it in the correct positions for riveting.

Stalling of the air motor takes place when the gear lug strikes a stop post, until the valve regulating the air supply is closed. The worm and worm gear being self-locking, the stake can, of course, be locked immovably and accurately at either of the two extreme positions of rotation. In the design of the jaw coupling, between the air motor and bevel shaft, considerable lost motion is provided for, to allow the crankshaft of the motor to turn a few revolutions and gain some momentum in starting up. This is desirable in order to aid in releasing the stake from its locked position.

Compressed air devices are of course used to a considerable extent in machinery for road construction and similar types of work, due to some extent to the fact that an air supply usually is available or can be produced readily. An application to a machine of this type is shown in Fig. 8 which illustrates an earth borer incorporating an air motor. The motor drives the main shaft of the machine and through this the chuck for holding the boring drill. It is said that the machine is especially speedy in operation, the smaller of two models built by the same company being capable of drilling a 3-inch hole under a 45-foot wide street in 18 minutes.

Reversible air motors also are available which possess the same facilities for easy control as the uni-directional type. Illustrative of the ap-

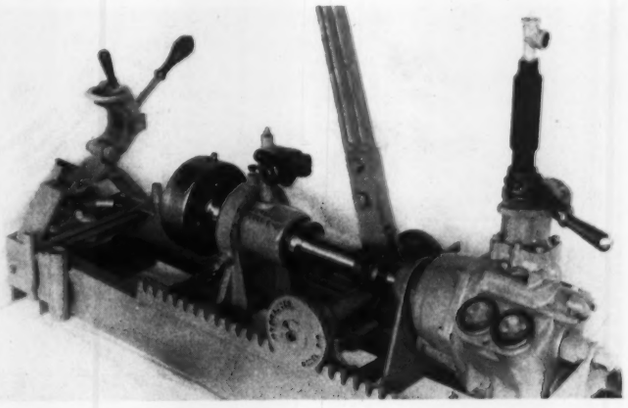


Fig. 8—Earth boring machine on which an air motor is used for rotating the drill

plication of such a unit is the incorporation of a reversing motor in a mechanism for tilting a ladle in a foundry. The motor is attached by suitable gearing to the ladle shaft and is controlled from an overhead carriage.

A cross section of a typical air motor is shown in Fig. 7, which illustrates a two-cylinder side-by-side unit with the operating valves placed at an angle of about 90 degrees with the cylinders. Recently considerable development has taken place in design of these units and the rotor principle is being adopted by some manufacturers. New uses for both types constantly are being found insofar as application in machinery is concerned. Units capable of developing as much as 10 horsepower are available, though the average application requires considerably less power than this. Indicative the horsepower obtainable and the corresponding speeds at which the motors run, are the figures given in the accompanying table covering a range, for direct drive motors only, of 2.3 to 5.6 horsepower.

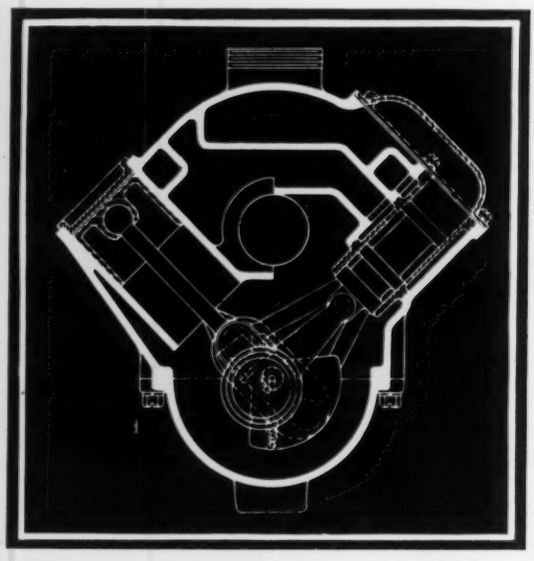


Fig. 7—Cross section of air motor

Steel Castings as Machine Parts

By R. A. Bull

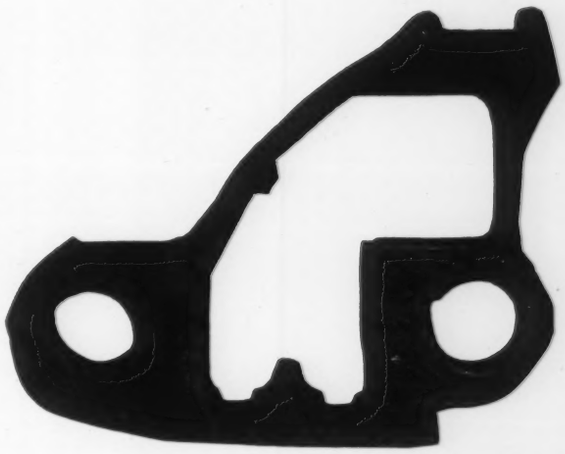


Fig. 1—Condition of casting after destructive machining to ascertain soundness following a redesign of casting shown in Fig. 6

UNIFORMITY of casting section, the important factor discussed in the preceding installment of this article, is associated closely with another element necessary to keep in mind when determining how best to connect members of steel castings to be used as machine parts. The other major factor, and the one to be considered in this discussion, is exhibited in the superbly effective way in which there are joined together those parts of man's anatomy whose functions are co-ordinated when physical effort is exerted. The properly developed human body is not angular. There are well rounded connections between limbs and trunk. There is an easily graduated junction between wrist and forearm; likewise where neck and shoulder meet. Nature has demonstrated to man in the proportioning of his own body—the acme of perfection in symmetrical design—how best to utilize strength either for applying or for resisting force.

Junctions represent dependability only when they are properly made. This holds true for a part made of any kind of metal applied either in its rough state or in its machined condition. Obviously the principle becomes of outstanding significance, indeed it is basic or fundamental, when one considers welded structures. Here, figuratively speaking, the heart is found in the joint, not in the trunk.

The second premise on which to found perfect steel casting design for machine equipment may be stated thus: The more noticeably angular a connecting member is, the weaker will be the reaction of the affected portion of the structure to severe stress. Putting it more tersely we may say: A sharp corner means low resistance.

It does not require the training of a metallurgist to enable one to realize why fillets of liberal proportions should be employed for connecting the members in any metal part. But it may help to put this important matter in proper perspective if there are recalled to mind some interesting experiments by testing engineers who have studied intensively this particular feature.

Laboratory Tests of Corner Effects

As long ago as 1871, Wohler, a pioneer among metallurgists, reported that axle steels he had stressed in repeated tension showed test results indicating that the square shoulders with which some of the axles were provided accounted for a strength loss of about 37 per cent as compared with axles from the same steels having narrowly rounded shoulders.

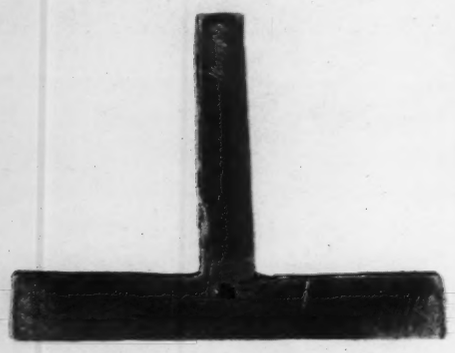
Several years ago Eden, Rose and Cunningham, English metallurgists, collaborated in the preparation of a report made before the British Institution of Mechanical Engineers. The authors pointed out that a well defined V-notch lowered the endurance limit of drawn mild steel approximately 25 per cent, and of hard steels about 40 per cent, in comparison with the same kind of parts made from the same steels, but provided with radii at the connections.

A few years ago Professors H. F. Moore and J. B. Kommers reported to the American Society for Testing Materials, some of their test data. In one case a 90 degree notch was made. In another instance a right angled connection was provided. In still another case a quarter-inch radius was employed. Then a one-inch radius was utilized. And finally a radius of approximately 10 inches was tried. These differing

DESIRABILITY of full co-operation between designer and foundryman is pointed out conclusively in the accompanying article, second of a two-part series by Major Bull, director, Electric Steel Founders' Research Group, Chicago. Some inherent weaknesses caused in castings due to incorrect design are cited, and suggestions offered for improvement in the finished part.

methods were used for connecting the test throat to the gripping ends of the specimen.

It was found that the employment of the V-notch reduced the endurance limit 60 per cent; that the throat connected by square shoulders reduced it 51 per cent; and that the quarter-inch radius reduced the endurance limit by 8 per cent; all as compared with the values for endurance limit determined in the same material



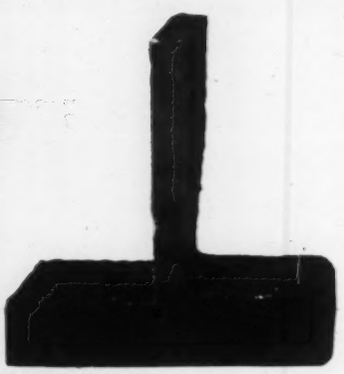


Fig. 2 (Above)—Crack and shrinkage cavity resulting from absence of fillets. Fig. 3 (Right)—Shrink-hole caused by sharp corner where flange was joined to plate

when the specimen had a connection between the throat and the holding ends machined to a radius of 9.95 inches. These experiments were made on ordinary steel containing 0.49 per cent carbon, heat treated before testing.

As to alloy or special steels, Moore and Kommers have cited results clearly indicative of the interesting fact that these metals are more susceptible than is carbon steel to surface conditions such as roughness, angular connections, etc. Seemingly the higher the grade of the steel, and the greater its potential resistance to severe stresses, the more important it becomes to have the part free from surface blemishes and irregularities, which under the microscope generally are shown to be of angular nature.

Service Results Confirm Scientific Data

All of these results obtained in the laboratory by men who are well grounded in the knowledge of metals have been confirmed abundantly by other men who, while not familiar with metallurgy as it is treated in text books, have acquired through experience invaluable information regarding performance of metal parts.

The steel casting probably bears a different relationship to the sharp corner than do most other metal products. This is caused by the phenomena that occur during solidification. All metals form crystals as they begin to cool, following the pouring operation. The condition of this crystalline structure, when it is beginning to form while the material is red hot, obviously is such as to offer little resistance to stress of material consequence.

The progressive cooling stage attending the solidification of steel imposes stress wherever there is any obstruction to the shrinkage or contraction which also accompanies cooling. Thus we have, in the case of liquid steel in sand molds, not only the gradual formation of crystals, but simultaneously with that, stresses set up by such resistance as the mold may offer to natural contraction. Of course this resistance is governed,

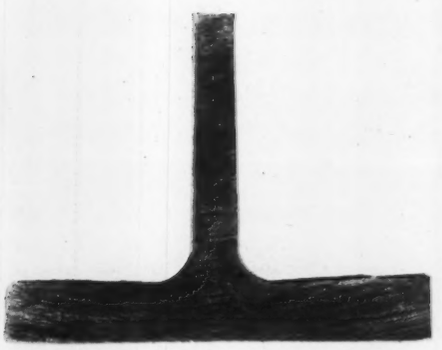


Fig. 4 (Below)—Presence of liberal fillets eliminated all shrinkage difficulties encountered in the designs shown in Figs. 2 and 3

in degree, by the design and other characteristics of the mold.

The resistance of the crystalline structure, such as it may be at any period of cooling or of subsequent heating, is due to a number of factors, including the alignment of the crystals themselves. Their position in relation to each other and to the cement-like constituents found between the crystals is a determining circumstance.

When a steel casting formed in a sand mold has connecting members which, for the sake of illustration, may be assumed to be at right angles to each other without connecting fillets there is no opportunity for the crystals being formed rapidly at the surface to be placed in alignment, except in some arbitrary position. This position may not lend itself readily to the development, while the material is plastic, of that degree of resistance which is afforded when a nicely rounded connection has been provided. In the absence of a radius there exist two dis-

tinct cooling surfaces abruptly connected; each a separate origin for crystallization.

The result is a continuous line of weakness, acting as a "stress-raiser," extended for the entire length of the angular connection. Considerable resistance, needed to prevent rupture during contraction, is missing. Thus there is likely to be a separation in the form of a crack, the visible appearance of which is of a dark color, due to oxidation, when the metal tears in its red hot condition.

It happens at times that the rupture in such a place occurs after the skin of the metal has frozen sufficiently to resist the tension; that is, a crack or check may exist beneath the surface but not be visible on casual external examination. This takes place occasionally despite the presence of fillets when these have radii that are too small.

The degree of shrinkage or contraction during solidification is relatively great in steel, as explained in the March issue of MACHINE DESIGN. This needs to be kept in mind when we realize that a liberal radius serves a double purpose, one of which has not been mentioned. It provides not only a satisfactory degree of resistance against tension while the part is still cooling after being poured, but it helps materially to compensate for the contraction that results in the reduced total volume of the casting. It has been shown previously that this shrinkage amounts, roughly, to ¼-inch per foot. The absence of the fillet often occasions a shrinkage cavity in the heart of a member, close to the intersection, while the skin may be unbroken. And at times there develops a combination of evils consisting of the interior shrinkage cavity and the exterior shrinkage crack.

Fig. 5—Sharp corners at junction of central with outside member caused shrinkage cavity on one side of casting, while fillets produced soundness

Illustrations of what happens when a steel casting is formed with disregard of the principle, which if followed would provide a more or less graceful curve where members are joined, are much more likely to be convincing than is purely textual description.

Fig. 2 shows a T-shaped portion of a steel casting made without any intention of providing fillets. In this case not only was a shrinkage crack formed, but there was a relatively large shrinkage cavity produced in the interior of the thicker member. Both defects originated from the same design source.

There is shown in Fig. 3, a section sawed from another steel casting also having a flange extending at right angles from a plate of somewhat greater thickness than the flange. In this case a fillet was provided on one side of the flange connection, while the other side was made with a sharp corner. The latter resulted in a shrinkage cavity quite close to and obviously produced by the angular design, because of the lack of metal at that location for supplying a void created by contraction. Naturally this contraction was of maximum extent in the thick plate immediately under the flange where the heat was concentrated and cooling proceeded most slowly.

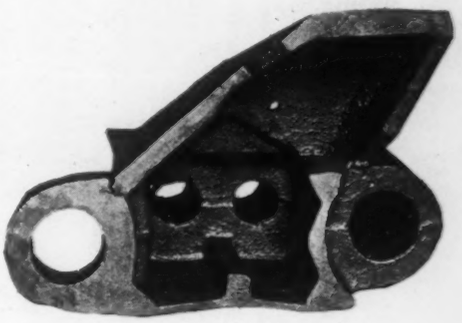


Fig. 6—Steel casting having several elements of improper design, metallurgically considered. One of these consists of an angular intersection associated with lack of uniformity of section

Liberal Fillets Provide Soundness

Fig. 4 shows a portion of a casting of the same nature designed differently in respect to the rounded connection. It will be noted that the piece was found to be perfectly sound after being machined destructively for careful examination. The simple addition of two liberal fillets where the flange joined the plate resulted in a sound casting; whereas without both of these fillets the part had been defective.

It has happened numerous times that a casting having members at right angles to each other, one joining the other in much the manner indicated in Fig. 3, has been required by the consumer to have a sharp corner on one side of the flange but suffering from no such restriction elsewhere. This was due occasionally to the apparent necessity of application

where another part in the assemblage was expected to have its sharp cornered surfaces in close contact with the adjoining casting. Probably in most instances of this kind such a fault could have been avoided if in the first place the designer had realized the inherent weakness which has been illustrated. Mechanical details for assemblage should be developed, whenever possible, without any such restrictions.

A pattern of such a nature as to cause trouble-

Fig. 7—Casting machined to determine extent of a crack in a vital location caused by bad angular connection between members of equal thickness

some shrinkage cavities in a location that was required to be perfectly sound was put in the sand in a steel foundry. The producer believed the difficulty could be avoided by adequate filleting. Proof of this was established by providing liberal fillets on one side of the cylindrical portion of the casting, while the opposite side was made with sharp corners where the central member was connected. The result of the experiment is shown in Fig. 5 in which a triangular shaped shrinkage cavity may be seen in the thick member in the proximity of the sharp corner. The result was that adequate fillets were provided for the thoroughly satisfactory execution of the remainder of the order.

In Fig. 6 may be seen the picture of a casting afflicted not only with radical changes of section but with angular connections; one of the latter regularly causing a shrinkage or hot crack in a vital part. The job was stopped for the consideration of a change in design. It was found, not only that the sectional irregularities could be lessened, but that the objectionable angle could be eliminated; and, further, that the casting could be made appreciably lighter by discarding a back wall and by making other changes. The redesign resulted in castings that were sound throughout as shown in Fig. 1 which illustrates a typical example among several castings destructively machined to determine the interior condition.

A reproduction of an interesting casting is shown in Fig. 7, where the objectionable corner condition was intensified by the degree of the angle. The characteristic shrinkage crack found in these castings when production was started may be observed in the picture made after sawing a casting in two to determine the extent of the crack. Obviously it was of a nature to add the casting to the scrap pile.

As in the case previously cited, there was a satisfactory degree of co-operation between the producer and the consumer. The engineer representing the latter adopted the foundryman's proposals regarding a modification of the shape of the piece by means of which several objectionable features, including the one that gave the most trouble, were eliminated. And in this as in the other instance, there resulted a material saving in weight for the consumer. The net result, shown in Fig. 8, meant economy to all concerned including those who bought the equipment in which the steel castings were components required to resist severe stresses.

Designer's Responsibility Important

It may be appreciated from this explanation of metallurgical conditions that exist, and from the illustrations of examples that show the practical significance of certain phenomena, that the engineer is in a position to help himself greatly by keeping constantly in mind the two

Fig. 8—Casting in its redesigned condition following difficulties experienced in one shown in Fig. 7

fundamental principles emphasized in this article as underlying perfect steel casting design. Every experienced foundryman knows there are many steel castings that give excellent service in which there is a dissimilarity of section of considerable degree. He knows also that there are some restrictive applications where liberal filleting would make complications that must be avoided. Nevertheless the producer knows that the maximum resistance to stresses of severe nature cannot be developed without adherence to those metallurgically perfect conditions of design which have been outlined.

Considering Machine Finishes from the Sales Standpoint

By William J. Miskella
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IT HAS been said that utility precedes beauty and surely this has been exemplified amply in the design of domestic machines. However, a radical change is taking place, and it may be expected that all domestic, office, and similar types of machinery in the future not only will embody sound mechanical features, but also will receive much more serious consideration from the standpoint of sales.

Perhaps the washing machine is the most outstanding example among the household mechanical appliances. The evolution of this particular machine has been most interesting. At first it was the old wooden tub with the hand-operated crank, but today we have an array of beautiful designs. Closely associated with these are the various new designs of clothes wringers, and this imparts much since their fundamental design had remained substantially unchanged for many years. During this development little or no finishing or ornamentation was used.

Now the combination washing machine and wringer is enclosed in an artistic metal cabinet of suitable modernistic design. So sure are the manufacturers of its acceptance by the public that they have gone to the expense of making dies to create a two-tone modernistic appearance which is in keeping with the modern trend. The acme of machine-made decorations, apparent evidence of the great adaptability of modern machinery and equipment—the factor which makes it possible to perform in the original stamping operation what formerly had to be done by hand—is shown in Fig. 1.

Those interested in making a profit out of vending machines might well be repaid for their thoughtfulness in equipping them attractively and with modern conveniences. This refers not only to the utility of the machine but to its general appearance. Incidentally, this is closely allied to the advertising which must be done in order to persuade the public to patronize automatic machines. For example, the modernistic slot-ticket weighing machine, Fig. 2, is provided with two chromium plated coat hangers.

Side and front panels of this machine are of stainless steel while the small blocks on the top of the cabinet are chro-

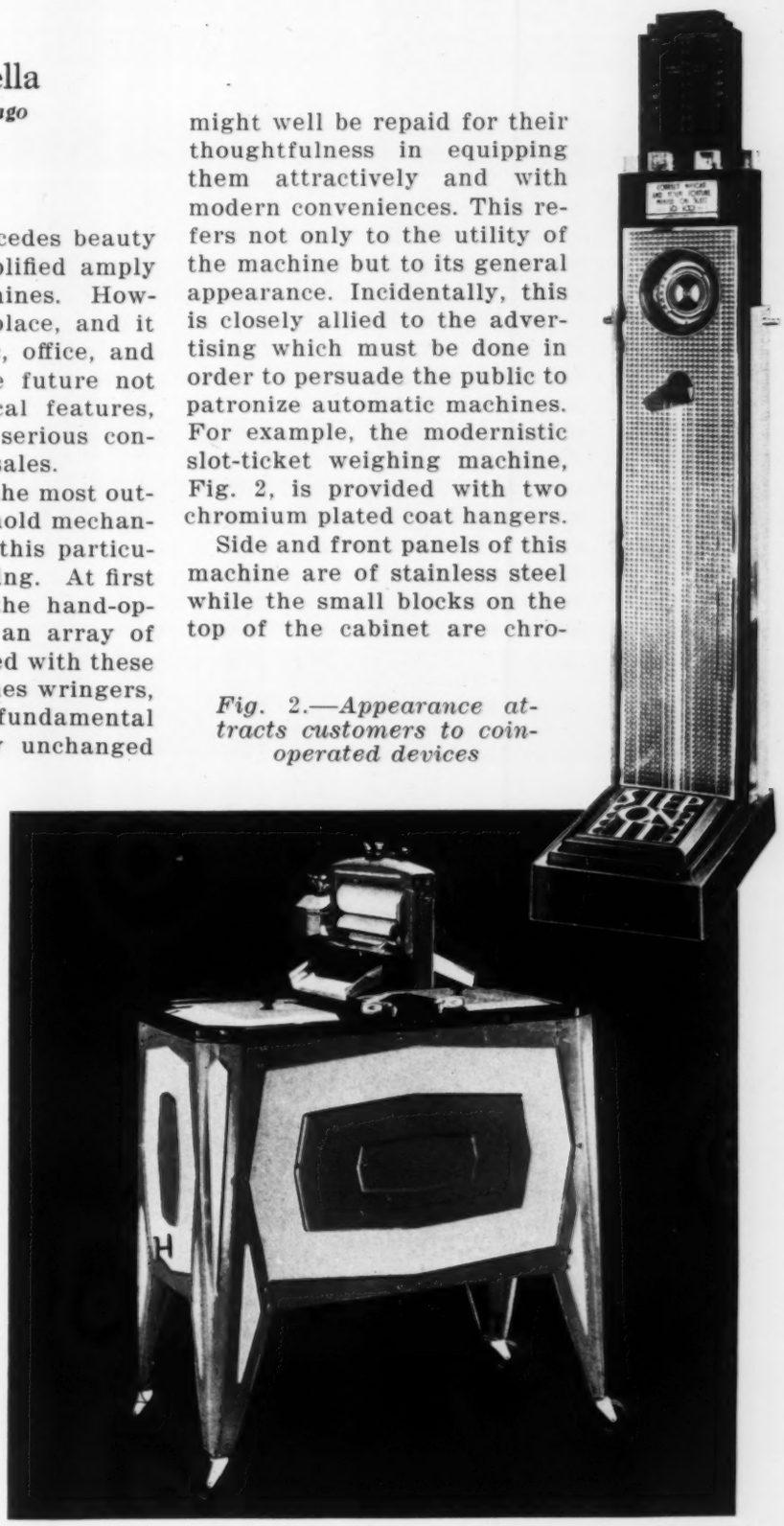

Fig. 1—Stamping operations aid finishes in preparing attractive design

Fig. 2.—Appearance attracts customers to coin-operated devices

mium plated. The complete mechanism inside is cadmium plated to prevent rust. Porcelain enamel is used on the base which is provided with a rubber mat carrying the design shown. The body of the machine is finished in baked black japan.

Thus it will be seen that in this vending device there are used a variety of finishes each for a particular purpose but principally employed to resist the elements and maintain an appearance which will be presentable at all times, for the prime purpose is to attract business to the inanimate sales device.

Fig. 3—Decalcomania transfers enable identical designs to be applied without excess cost

Sewing machines and typewriters are fine illustrations of machines which have held to the use of decalcomania transfers for cutting the cost of striping and decoration. These, for example, are used in applying ornate designs and the especially designed lettering which must be uniform. Such designations must present a workmanlike attractivenes at all times without any evidence of variation. Therefore, decalcomanias may be used to accomplish the purpose when there are enough duplicates to be made to warrant the expense of making these carefully planned and richly colored decorative designs.

The typewriter in Fig. 3, a continuous fanfold biller, shows a single panel stripe on the side. This is applied by means of a decalcomania and not by hand. The name of the machine is applied in the same way as well as the trade mark to the left of the name. This trade mark contains a perfect miniature view of a typewriter ¾-inch square on a three-color background.

These decalcomania transfers are made by a combination printing and lithographing process which takes several weeks to complete. Once they are on hand their application is a simple matter for a girl or any employee. After the transfers are in place a coat of suitable varnish might be applied over them to prolong the life of the design. As a rule, however, this transparent protective coating is unnecessary.

Even the garment pressing machine used by the cleaner and dyer comes in for its share of decoration. Not so much because of the embossed molding used on the front of the base, Fig. 4, or of the molded design in the foot pedals, but because of the use of the two-tone wooden stripes in the operating table which is large enough to arrest the attention of the observer. This distracts his attention from the mechanical parts.

The foregoing indicates an important trend of special interest to the designer of machines. He will, in addition to perfecting machines from an operative standpoint, have to give due consideration to the decorative possibilities—not after the machine is completely designed, but while the design is in the process of evolution. Then too it is entirely possible to extend the utility of the decorative means to that of structural strength. A certain sheet metal part of a machine might be flimsy and unattractive if used flat; while, on the other hand, it could be made strong and at the same time attractive should decorative embossed strip or some special design be incorporated in the stamping die.

There is little doubt but that machine designers of tomorrow will have to be educated to some extent along artistic as well as mechanical lines. In some organizations it already has become the practice to submit articles to an art director after the engineering department has completed its work. Of course, this procedure is only a makeshift to fit in with the conditions as they are found today. The next step probably will be to have the art director work in close harmony with the designer of the machine and thus incorporate in the design, as the work progresses, whatever features are thought necessary to arrive at a satisfactory result.

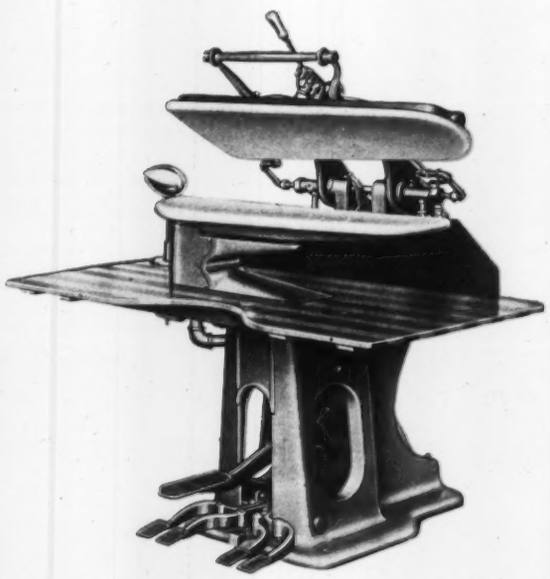

Fig. 4—Paneled pressing board draws attention away from mechanical details

Mechanical Difficulties Overcome in Welding Spiral Pipe

By Leon Cammen
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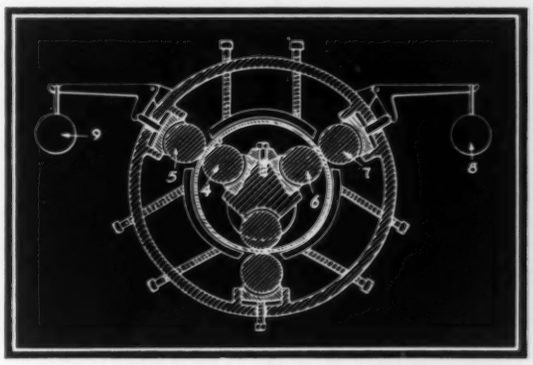


Fig. 2—Counterweights regulate pressure on rolls which turn the pipe

ATTEMPTS to weld spirally coiled pipe by the electric resistance process brought up a puzzling mechanical problem. In resistance welding it is necessary to produce considerable pressure in the seam at the place where the weld takes place. On longitudinally welded pipe this is comparatively simple, as the pipe does not have to turn while it is being welded. In the case of spirally coiled pipe, on the other hand, the pipe turns, and pressure obviously cannot be produced by the mere squeezing of the edges of the seam.

Several constructions have been developed, therefore, with a view toward producing the necessary pressure. All of them work, and it is for the designer to determine which one he may use for a given set of conditions and a given size of pipe.

MECHANICAL movements that will apply sufficient pressure for rotating a cylindrical body by friction and at the same time move that body forward have numerous uses in design, and yet there is notable scarcity of information on such devices. The accompanying article presents a discussion of several arrangements of this type used in welding spiral pipe.

The simplest, and incidentally the least satisfactory, solution is shown in Fig. 1 where 1 is the seam formed in coiling the pipe. Four rollers such as 2 and 3 are provided two on the outside of the pipe and two on the inside, so located that one pair is on one side and the other pair on the other side of the seam. Only the outside or the inside rollers need be driven, although if desired there is no harm in driving all four. The trick in this construction lies in the fact that the axes of the rollers are not parallel to or coincident with each other, but are set at an angle, so as to close the seam.

The device is efficient and permits close regulation of pressure in the seam. Its great disadvantage lies in the fact that cylindrical rollers cannot very well be used. Hence, hour-glass rolls have to be used instead, concave on the outside and convex on the inside of the pipe and this means a set of four rolls for every size of pipe. Such rolls are costly and their maintenance is a problem.

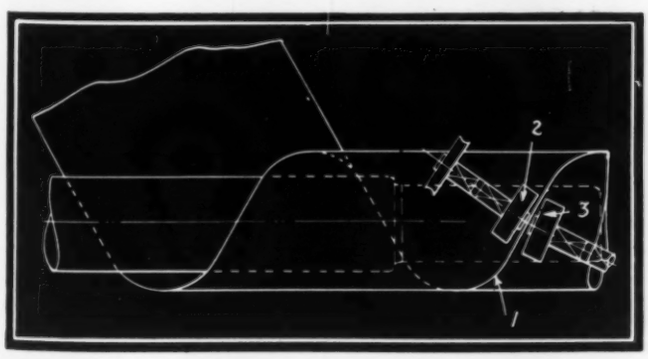


Fig. 1—Simple solution of the problem of turning the pipe and advancing it at the same time

Fig. 2 apparently gives an excellent solution of the problem. Its only disadvantage is that as shown it will not work, though it does work with a slight modification. In its simplest and nonoperative construction, Fig. 5, a little pin projects through the pipe, with a flat top that looks like a Chinese umbrella. The welding rolls, used in Fig. 2, are located in the next seam to the left on the top of the pipe in line with this pin. As the seam is a spiral one it is obvious that if the pipe be turned the presence of the pin in the seam will cause the pipe to advance; this is an old construction.

If the pipe is held to the left of the place

where the weld occurs and is turned, it would tend to coil up tighter and finally press against the pin. This causes the whole pipe to move to the left, and produces a pressure in the seam at the place where the weld is supposed to take place; this pressure being a function partly of

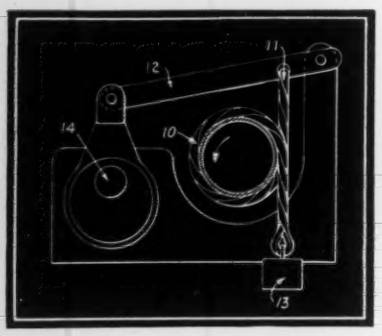


Fig. 3—Efficient pressure and turning action is provided by ropes wound around the pipe

the power with which the pipe is twisted and partly of the resistance (frictional) produced by the pin. If this resistance is not sufficient, it can be increased by applying a brake to the pipe, preferably between the pin and the place of welding.

In solving the apparently simple question of turning the pipe, the design shown in Fig. 2 would seem to be the logical answer. The pipe is gripped between two sets of rolls, such as 4 and 5, 6 and 7, with counterweights, such as 8 and 9 to regulate the pressure produced by the rolls. Why then will it not work? As the seam in which the pin is located is a spiral one, the pipe must have a spiral movement, moving both forward and rotatively. If the rolls grip it sufficiently to produce the rotative movement they obviously will oppose the forward movement of the pipe, and if they are arranged so as to permit the pipe to slide forwardly between them, the grip on the pipe will not be strong enough

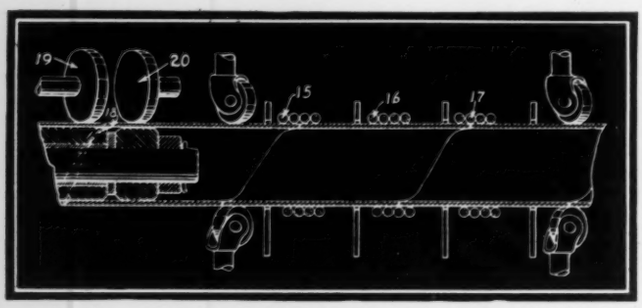


Fig. 4—Three ropes provide more uniform action

to produce a rotation and particularly will not provide enough pressure at the place of welding to permit welding by the resistance process.

A simple answer to the problem is to replace the cylindrical rolls by hour-glass rolls. This will work but has the same objections as the use of hour-glass rolls specified in the foregoing for direct closure of the seam. A much more effective device is shown in Fig. 3. Assume that rope 10 is wound once or twice around the pipe and that this rope is attached at 11 to beam 12, while the other end of the rope carries weight 13. If the beam is raised as, for example, by eccentric 14 the rope will turn the pipe, as the rope acts in this case as a snubber. On the other hand, when beam 12 comes down the weight 13 will pull the rope tight and at the same time help to move it forward.

This weight does not have to be great to produce a powerful pull on the rope when the beam goes up, and when the beam goes down the rope will slide comparatively free. This will give a short turn of about 180 degrees but only part of this distance can be utilized to turn the pipe unless a complicated cam motion is substituted for the simple eccentric.

If three ropes are introduced, such as shown in Fig. 4 at 15, 16 and 17, and the eccentrics are arranged properly, a better cyclic diagram will

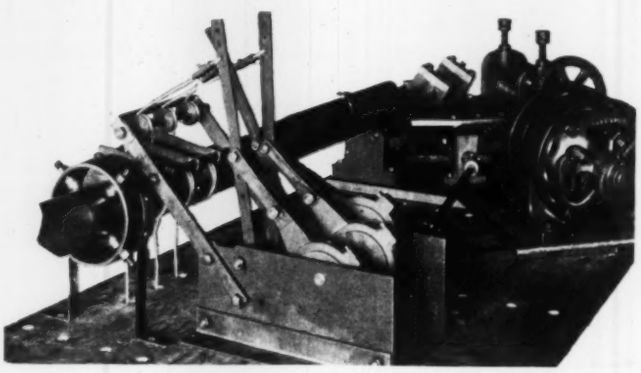


Fig. 5—Development model of turning apparatus shown in Fig. 2

be obtained. The beginning and the end of the pull of the rope are slow and produce comparatively little power. However, the cycles of each rope are partly superimposed on the cycle of the next with the result that a fairly uniform pull and turning action are obtained.

With six ropes a practically constant pull can be effected. In Fig. 4, 18 is the place where the welding occurs and 19 and 20 are the welding rolls. The pull of the rope is best made upwards, and unless some precaution were taken would tend to distort the pipe. To obviate this the frame carrying casters is arranged to permit the pipe to turn as well as advance and at the same time to keep it from distortion. This device works exceedingly well. The design in Fig. 3 is not an efficient one unless the beam be made inordinately long as the stroke of the rope is short. Because of this the horizontal beam 12 was replaced by the vertical beams shown in Fig. 5, the ropes running over the pulleys.

This arrangement works, but has the disadvantage that even with six ropes it is somewhat jerky; an action that is apt to affect the character of the weld. If the rope were replaced by solid elements such as wrenches, grippers, or the

like some of the jerkiness might be eliminated, but unless the surface of the pipe is rough, solid elements, unless made in the form of pipe wrenches, will not work, and pipe wrenches mark up the metal of the pipe.

Another disadvantage of solid grippers lies in the fact that they may fail to work because of the presence of the welding flash. In resistance welding a prominent burr is produced from the metal thrown up by the compression and the action of the current. The welding is carried on so that this burr, or flash as it is usually called, is thrown onto the outside of the pipe, the interior being as smooth as possible. The purpose of this is to place the flash where it can be taken off by grinding or planing, but it exaggerates the flash on the outside. A rope, carried around the pipe in two turns, will grip the pipe notwithstanding the presence of the flash; a solid gripper will not.

Endless Rope Is Most Effective

By far the most effective arrangement for turning the pipe and imparting to it a forward motion at the same time, or rather permitting it to have such a forward motion, is shown in Fig. 6. In this case an endless rope is carried around the pipe, not circumferentially, however, but spirally, as shown at 21. The arrows show the way this rope is wound. It is carried over a groove in sheaves 22 and 23 and back over a groove in sheave 22, then over pulleys 24 and 25 and around the pipe to pulley 26; these grooves are not spiral but circumferential. The power is applied to the shaft of sheave 22 while sheave 23 merely regulates the tension in the rope by spring 27.

The advantage of this drive lies in the fact that the ropes preserve their position with respect to the spiral of the pipe itself, and therefore never come into contact with the flash of seam 28. Its disadvantage lies in the large amount of room along the axis of the pipe that it occupies.

To obviate this, the arrangement shown in Fig. 7 has been developed. This consists essentially of two such sets of sheaves and pulleys as shown in Fig. 6, except that the sheaves are made in single pieces; six pulleys instead of three are provided. The rope starts in the same way as in Fig. 6 i.e. from sheave 22 to pulleys 24 and 25; it then goes around the pipe as shown but instead of going over pulley 29, corresponding to 26 in Fig. 6, it goes over pulley 30 onto the right hand part of sheaves 31 and 32, then over another set of pulleys corresponding to 24 and 25 of Fig. 6, of which only the former is shown as 33, then around the pipe and onto pulley 29, and left hand side of the sheaves. In this way an endless rope is enabled to make two turns about the pipe, both along a predetermined spiral.

The matter of the speed with which the rope is driven has to be determined carefully. If this drive is too fast, it will open the pipe seam instead of closing it under pressure; if the drive is too slow, there will be an accumulation of material back of the pin.

There is a notable scarcity of mechanical movements designed to produce a spiral movement capable of developing considerable power.

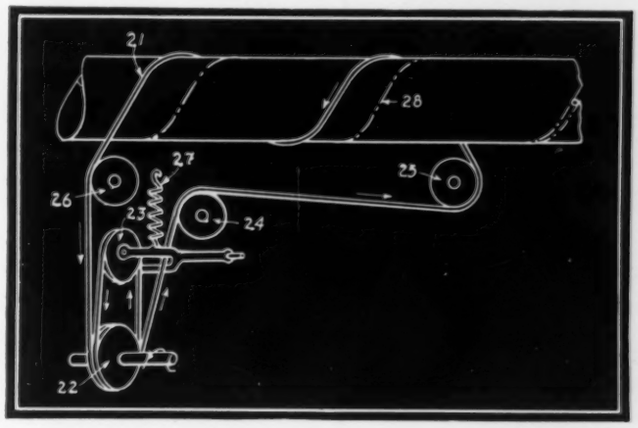


Fig. 6—Most effective arrangement for controlling pipe movements is by endless rope

Such a movement might find application in drilling equipment, in conveyors, in polishing long rods, etc. The advantage in employing wire rope as a means of transmitting power from the motor to the piece being turned, as described in the following, lies in the fact that the rope is flexible and automatically adapts itself to the given diameter of the piece being handled. It is capable of producing a drive of desired rigidity, the coefficient of "adherence" varying from

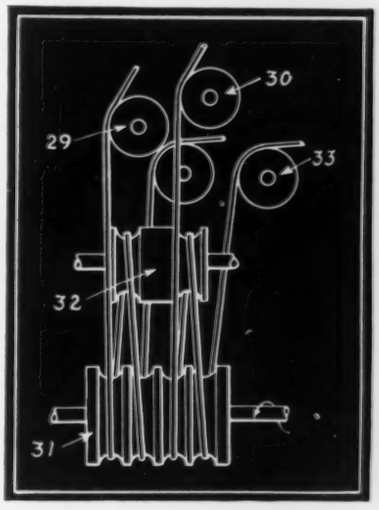


Fig. 7—More compact arrangement of pulleys for endless rope drive shown in Fig. 6. This design requires much less space

8.5 for one turn of the rope through 65 for two turns, to many millions for 6 and 7 turns of the rope. Therefore a rope drive can be made far more rigid than is possible with any other form of grip, and yet it is not so apt to mar the surface of the piece being turned.

Improving Drafting Management by Squad Organization

By F. D. Newbury

DURING the past four years some new ideas have been applied to drafting management in several design departments of the Westinghouse company that may be of general interest. The use of these methods has cut drafting costs in half, while average salary rates have been increased, design quality has been improved, and drafting accuracy maintained.

Before these new ideas were introduced, these departments were organized along conventional lines. Each department was divided into a number of separate engineering sections each of which was responsible for the initial design work connected with a specific class of apparatus.

Each Department a Complete Unit

In the type of organization that has been developed, each department is divided into a suitable number of design units (called divisions), each complete with electrical or mechanical engineers (or both), design and detail draftsmen, and in charge of one engineer-executive who directs and co-ordinates the work of both engineers and draftsmen.

A second distinctive feature of this type of organization is the grouping of draftsmen of each division into relatively small squads containing one to five men. Each squad is in charge of a squad leader, who is a qualified designer. He makes the general layouts assigned to his squad, assigns the work to his assistants, and supervises their work. The squad leader has a definite design and production responsibility for the work assigned to his squad. They are specialized both as to the kind of work assigned and as to the kinds of work performed by the individual members. A broad distinction is made between design work, such as covered by layout drawings and detail drafting work, represented by the production of working drawings.

The flow of work through the department is controlled by a production supervisor who has no responsibility for drafting management. Under the direction of the division head he assigns new work to the squad leaders, assigns completion dates for each detail drawing, and conducts all negotiations with works production men.

Personal Supervision Necessary

Under this plan of organization, the head of the design division must take a considerable interest in drafting personnel and production, if the desired results are to be attained. Too frequently the supervision of the drafting part of the design organization is delegated to an executive who lacks close touch with the commercial, technical, and manufacturing aspects of the whole design problem. The division engineer has these broad contacts and is expected to handle directly all personnel and management problems connected with drafting and engineers.

It is possible for a large design organization to combine the strength and ability inherent in the large group with the speed and mobility inherent in the small group, if the large group is divided into a sufficient number of small groups, each constituting a complete self-contained design unit.

Practically all checking of drawings by separate checkers has been eliminated by training detail draftsmen to check their own work. Careful records of drawing changes are maintained to show the class of change and the responsible individual. Carefully maintained records have shown no increase in errors per drawing due to this system. Experience has shown the weakness inherent in the divided responsibility for accuracy that exists when separate checkers are used. When separate checking is a part of the established routine, the detail draftsman leans more and more on the checker with an increasing deterioration in his own thoroughness and accuracy.

The work of making new detail drawings has

METHODS which have cut drafting costs in half, while average salary rates have been increased, design quality improved and drafting accuracy maintained, are described in this article abstracted from a paper presented at the Three-M Congress, at Cleveland, sponsored by the American Society of Mechanical Engineers. Mr. Newbury is general manager, machinery engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

been reduced greatly by providing so-called master tracings (only partially complete) from which lithoprints are made, and the new lithoprint "tracing" is completed by the detail draftsman. In many cases of drawings of standard parts, only dimensions need to be filled in to complete the lithoprint from the master tracing.

In measuring the useful output of a drafting organization, the single drawing—large or small, simple or complex—is most frequently taken as the unit of measurement. Sometimes the total square feet of drawings produced is used, but this measure also has obvious shortcomings. In the plan developed in the first design organization under discussion, the range of working drawings produced is divided into nine classes, depending upon the amount of work involved in making the working drawings, ranging in time from 2 to 40 hours. This time allowance, covering making and separately checking the pencil drawing, is intended to represent the time the drawing should require under ideal conditions. Each drawing, after it is completed, is given a "par hour" rating. This figure is analogous to "allowed hours" for factory jobs.

The results of the operation of this par-time plan are shown in Figs. 1 and 2. Fig. 1 shows the various performance ratios that have been described. The first curve, showing the ratio of actual hours to par hours for new pencil drawings, is of most value as a measure of individual

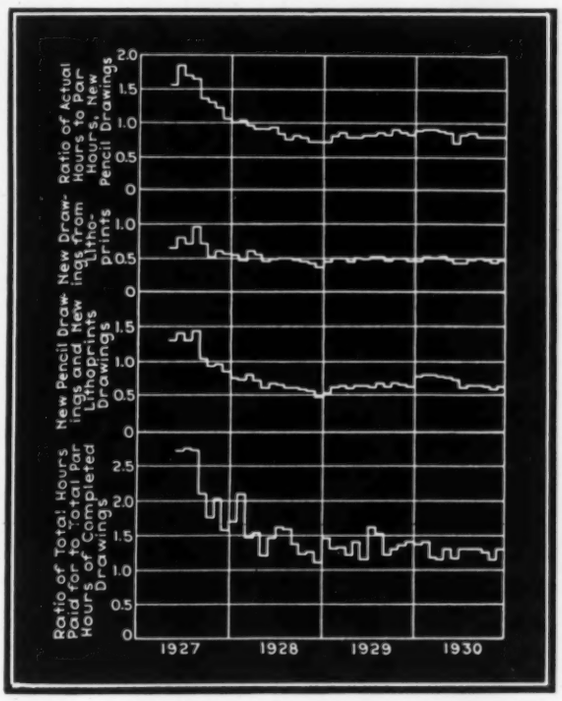


Fig. 1—Performance ratios obtained by application of par-hour plan

man efficiency. In the case of the second curve, for new drawings made from lithoprints, the par-time allowance is the same as for a complete new pencil drawing. This ratio, therefore, should be materially better (lower) than the ratio for new pencil drawings. If it is not, it means that poor judgment was used by the squad leaders in using existing tracings as a basis for new drawings. This second curve and the third, which is the combination of the first and second, is of value mainly as a measure of squad, division, and department efficiency. Satis-

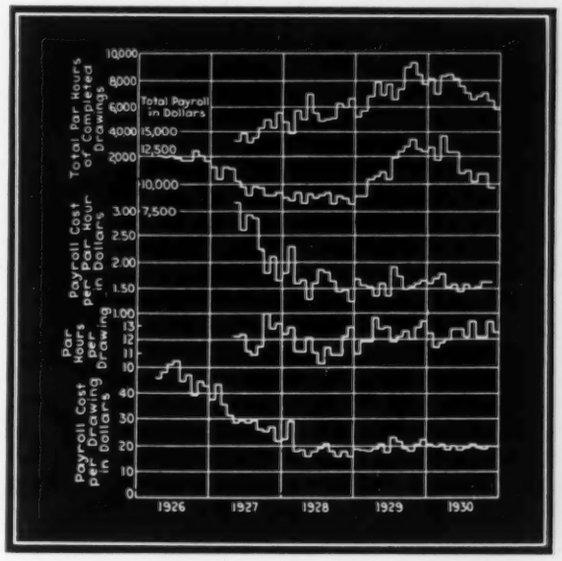


Fig. 2—Results of par-hour plan in terms of costs of drafting

factory performance, as it is now judged, can be achieved only by producing a major part of the required new drawings from existing tracings.

The fourth curve represents the total or "overall" ratio, which is the most important. This curve is more irregular than the others because it includes absent time paid for.. This is the reason for the relatively higher peaks in July and August.

Fig. 2 gives results in terms of costs of drafting. The total useful output is shown in the curve of total par hours of completed drawings; the total payroll cost is shown, and the other curves are derived from these.

The curve of average par hours per drawing is interesting in showing how the "work content" of drawings may vary from month to month, even in the same department. When these same data are taken from different departments handling different types of apparatus, the differences are much greater.

It may be possible to base salary payments directly on these performance ratios, but up to the present time the dangers inherent in such an inflexible, mathematical application of the ratios have been considered too great to risk. When a plan of measurement directly affects the pay envelope, every figure used in the formula will be questioned. This par-time plan has been effective partly because it has been used with good judgment.

Roller Friction Clutch Unit Is Simple and Accurate

By George T. Chapman

Consulting Engineer, Detroit

ALTHOUGH the ball friction clutch now is being used in the free wheeling mechanisms of several automobiles, it has not been adapted generally in machine design due probably to a misunderstanding of its action or the difficulty that may be experienced in manufacturing of the conventional type as shown in Fig. 1.

This design has no advantages what-so-ever over the design of the roller type shown in Fig. 2, the latter lends itself much more readily to manufacture and at the same time affording the advantage of replacement of the main wearing block, *A*.

The advantages of this type of clutch over that of the ratchet, are:

1. Accuracy of feed or movement. There is no lost motion in pickup
2. No fixed movement
3. No load limit and greater load capacity in proportion to size
4. Wearing parts easily replaced
5. Inexpensive to manufacture
6. Longer life

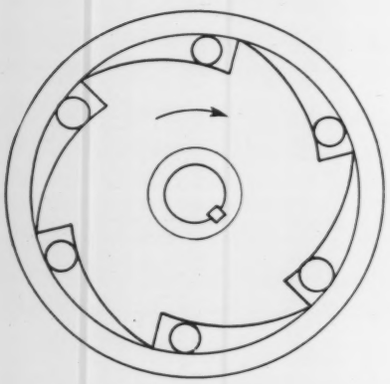


Fig. 1 — Conventional type of ball friction clutch commonly used on free wheeling mechanisms

In Fig. 3, if angle α, between the tangents to the curves of ratchet and shell at points of roller contact is less than twice the angle of repose, the clutch will either drive or break. The forces

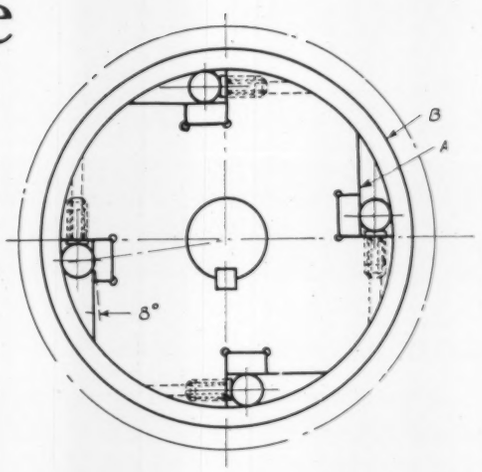


Fig. 2—Roller type clutch has greater load capacity in proportion to size

acting on the roller are fP on the ratchet side which is the propelling force and fP on the side of the shell the tendency of the roller to drive the shell. Angle β is evidently equal to the angle whose tangent if f (the coefficient of friction) and is also evidently equal to $\frac{1}{2}\ \alpha$, therefore α must be made slightly less than twice the angle of friction.

Pressure Against Rollers Important

If α is much less than twice the angle of friction it will not let go. If it is greater than this the pressure against roller is the controlling influence that may cause it to work or fail. The angle of friction varies with the lubrication and may be two or three times as great with one oil as with another, to say nothing of still greater variation with no oil at all.

The driving force is anything up to fP at the circumference of the shell where f may be taken as .03 according to conditions, material and lubrication. With 0.03 as the coefficient of friction, P will be 33 1/3 times the pulling force which will equal the crushing force on the roller.

From experience the writer has found that it is advisable to keep this crushing force down by making the angle of repose 8 degrees and backing the roller up with a force supplied by a spring plunger as shown in the assembly Fig. 2, and by so doing reduce the crushing force from 33 1/3 to 3.56 times the pulling force, i. e.

$$\tfrac{1}{2}P \cot \alpha = \tfrac{1}{2} \times 100 \times 7.1154 = 356 \text{ pounds}$$

Taking A as the diameter on which the rollers

work, the following proportions may be used in the design of the roller clutch:

Roller diameter$=A/10.66$
Thickness of block$=A/16$
Width of block and roller$=A/8$
Pressure in pounds against roller$=A/1.6$

For small clutches the hardened steel ring in-

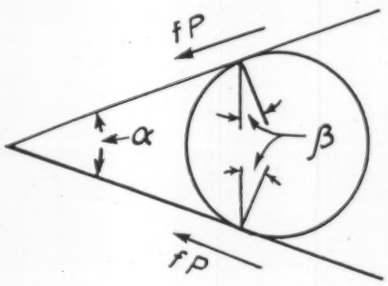


Fig. 3—Diagrammatic representation of forces acting on rollers

sert *B* will not be necessary. However, where great strength is required it is advisable to harden and grind this ring and then force it in the steel or cast iron housing as shown.

Work Graphs Visualize Personnel Activities

By L. F. Remington

AN EFFICIENT and simple method for recording time spent by engineering and drafting department personnel is the work graph. This method possesses unlimited possibilities in structure and study. It pictures with remarkable accuracy the work activities of an individual showing vividly the extent and variety of work accomplished, unforeseen and unnecessary interruptions, actual time spent on jobs, and general trend of work.

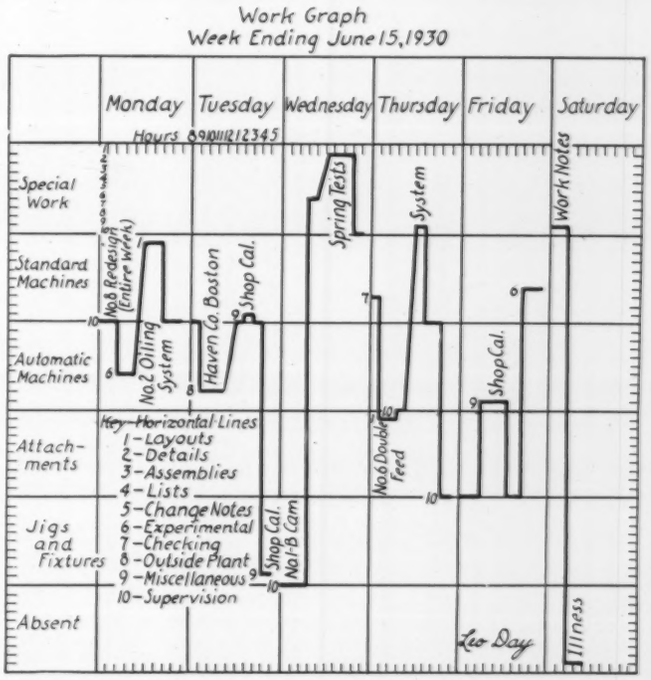
The graph offers ready reference for job analysis or investigation. As a work and job record it has proved invaluable and may be used as a basis for determining departmental accomplishments and also time estimates on future work.

This method gives complete working knowledge of a department to executives for study purposes with the thought of intelligently delegating and directing work to individuals according to their ability and salary, which is the foundation for true economic executive supervision.

Graph sheets are standard prepared forms which may be changed in body structure to satisfy various classes of work. The daily recording of time on a graph requires approximately three minutes. Minimum of job time recorded is one-half hour.

For proper preparation and reading of the graphs, each of the ten horizontal lines in the squares represent a class of work, and the nine vertical lines in each square represent hours of the day. A line drawn along a horizontal chart line indicates that the engineer was employed in the class of work represented by that line, and that the work was on the general classification shown by the major heading along the left column. The length of these horizontal lines shows the time spent on this work. For example, a horizontal line along line 7 under the general heading of Automatic Machines, which runs from the first vertical line to the third, indicates that the engineer was employed in checking work on automatic machine design from 8 o'clock to 10 o'clock.

The possibilities of this method can be realized best by a brief study of a sample designer's graph. The first impression received is that of variety of work. This means little opportunity for deep concentration on any particular subject. The work is essentially of a supervisory nature. It is quite evident that the individual



Sample graph for typical week showing variety of work requiring one man's attention

must be capable of making quick decisions and have a commanding knowledge of various classes of work. The jobs on Tuesday and Friday were interrupted by shop problems which required four hours time. Wednesday there was an unforeseen interruption on special work. The feasibility of delegating such work, if continuous, to lower salaried employes should be considered carefully. The actual time spent on each individual job is easily obtainable.

Editorial

Do Chief Engineers View Their Positions in Correct Perspective?

IF IT can be assumed that engineering literature reflects accurately the thinking of engineers, then it is apparent that an important phase of engineering work is being neglected. Thousands of books have been written on materials, mechanics, design and other phases of the theory and practice of engineering but practically nothing has appeared which defines the functions of an engineer.

This discrepancy also is found in engineering education. The student is given instruction in the fundamentals of technology, but little advice is offered him as to how he shall approach a position as engineer or how he shall handle its problems.

The duties of sales managers are defined clearly in numerous books and are taught in a number of schools. Production officials are afforded ample knowledge of the most detailed features of their work. But even the best of books on management are practically silent as to how the chief engineer fits into the industrial picture.

It is time for engineers to give more thought to the management aspects of their positions. They should analyze their functions carefully—especially to see if they are placing the proper emphasis on the numerous divisions of their work.

They will find that their problems are divided readily into two classes—internal and external, and if they are fair in their analysis, many of them will discover that they have been devoting too much time to the internal problems.

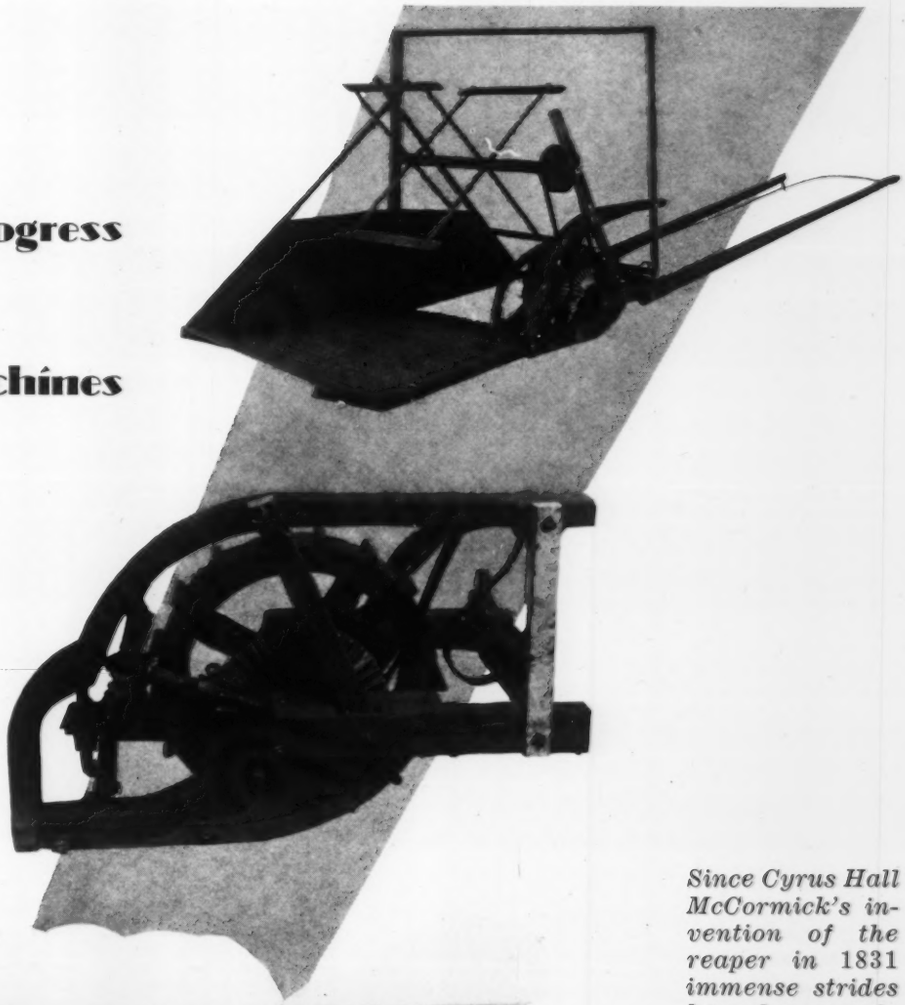
The initial article in this issue is intended to help engineers in charge of design to view their chosen work in broader perspective. Careful analysis of the engineer's relations within and without his own department is absolutely necessary if the profession is to advance to the position it richly deserves.

Pooling Ideas to Increase Business

UNDER some circumstances the pooling of design ideas by builders of similar types of machines is a progressive step. A policy of this kind, under cross-licensing agreements, has been followed by automobile and aircraft manufacturers in this country for many years.

More recent is the amalgamation of producers of nine-tenths of the electric cooking stoves made in England, who have sunk their differences and combined in an effort to combat developments in cookers of other types. Similar action on the part of builders of certain kinds of machinery, particularly those hard hit by the depression, might go far toward helping them keep their heads above water until business recovers.

A Century's Progress in Harvesting Machines



Since Cyrus Hall McCormick's invention of the reaper in 1831 immense strides have been made in design, as depicted on this page

Not steel, but wood construction was used in the first machine shown in top right hand corner; beneath it is close-up of the drive mechanism. At right is shown a steel machine introduced in 1885, and above, a modern machine which not only reaps but threshes

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

This Machine Age!

To the Editor:

MANY of the criticisms of the present age of machinery have come to my attention and I believe that the writers of these complaints are not sincere in their efforts. They sit before a typewriter loaded with easily obtained paper, in a comfortable heated room, illuminated by electric light (all products of the machine age) and write that we are living in an age which is a step backward from some earlier age. I do not believe that these same writers would willingly change their present life for one in the middle ages, with its filth, disease, witchcraft and ignorance.

That our present civilization is not perfect is obvious. However, the entire blame for its faults cannot be placed upon the shoulders of scientists and engineers. These men and women heretofore have worked largely in the status of servants bringing forth many marvels of science and having little or no control over the production and distribution of the results of their labors.

In recent years engineers and scientists have begun to take a greater interest in economic and social problems, as ably pointed out by the authoritative views given in the March number of MACHINE DESIGN. With the increasing participation of these men in business control some of the present evils of machinery will be overcome. But whether or not the people of the world will use their increased leisure to good advantage will depend upon how well they are guided or educated. That is the work of others than scientists or engineers and designers.

—ERWIN H. HAGEN,
Appleton, Wis.

To the Editor:

I HAVE read with interest the article entitled "Will Criticism on Machine Age Retard Design Activity," appearing in March issue of MACHINE DESIGN. My answer to the question as it is put would be "no." The machine building industry as the employer of machine designers has no moral conscience and is not susceptible to criticism, but it has a very sensitive ear to business prospects. Without business prospects, there is no machine design. However, judging from the drift of the article, the real question seems to be: "Is the Engineer, the Machine Designer, Responsible for the Business Depression?" This question should be answered with an emphatic "No."

Fifty years ago theories and principles in economics were evolved that, if put into practice, would permanently cure the unemployment situation. There would be no limit to production except the inability and disinclination of the people to work, and a lack of raw materials. The cause of this industrial depression and universal unemployment lies in our financial system, despite the fact that we have "the best banking system on earth." And the solution may be expressed in two words: "Commodity Money."

I want to stray no further into economics. What I contend is, that the machine designer should study political economy in self defence, so long as society is pointing the accusing finger at him. He may even be called upon to solve the problem, since the economic science fraternity has failed to do so.

Let no engineer be worried by his conscience, or assume the guilt for this deplorable condition. The problem is one of economics, not of engineering. The development of economic sciences does not seem to have kept pace with engineering development.

—R. G.
Milwaukee

Accurate Drawings vs. Shrink

To the Editor:

ACCURACY of a high degree is required in the making of alignment charts, graphs and similar work. It must be remembered that the accuracy is limited strictly by the amount of stretch or shrink of the paper or tracing cloth. Degree of stretch being dependent upon the weather and the temperature, the drawing will be accurate only when we know the

amount and direction of this warpage.

The remedy for this is to draw on the chart a circle of precisely 5 inches diameter (or a multiple thereof), the diameter being noted on the drawing. This circle should be drawn using a fine line and can be made quite inconspicuous. This is the "shrink test" circle. Whenever the chart is to be used the diameter of the circle is checked at a number of points. If the diameters are alike and equal to the original figure, no stretch has occurred and the drawing is true. If the circle is found to be elliptical, the percentage of stretch or shrink is computed readily and this factor used in reading the chart. By this means the amount and also the direction of warpage is determined.

This kink will be found of particular value when photostats are to be made from the drawings, or blue prints from tracings, for in these instances there is a double shrinkage, once in the original and once in the reproduction.

—A. W. EIDMAN,
Shaker Heights, O.

Blueprints and Photostat Lines

To the Editor:

A SATURATED solution of binoxalate or quodro-oxalate of potassium ($KHC_2O_4 + H_2O$) or ($KHC_2O_4 + H_2C_2O_4 + 2H_2O$) will give better, sharper and whiter lines on a blueprint than the usual "soda solution," and such a solution does not spread or turn the paper yellow. It should be noted that both the above are poisonous acid salts, commonly called "salts of sorrel," much used for cleaning straw hats. It has been found best to put about an ounce of the commercial salt in an eight ounce bottle and fill it with city water, or preferably distilled water. In twenty-four hours the clear liquid can be used. It should be labeled with the date, amount of ingredients, and, in large letters "poison." The small desk bottle is filled from the eight ounce stock bottle, and as the clear liquid is consumed water is added until all the potassium binoxolate becomes dissolved.

To make sharp and clear white lines on brown prints or photostats "Bernays Antiseptic Tablets," composed largely of corrosive sublimate mercuric chloride ($Hg\ Cl_2$), are extremely applicable. One large tablet of about 15 grains will make four to eight ounces of solution amply strong for making white lines, the amount depending upon how quickly it is desired to produce the lines. Ordinary $Hg\ Cl_2$ can be used, but the Bernay tablets are very convenient and some consider their other ingredients helpful. After this solution is made up it should be labelled clearly, and not be further diluted as used.

Some of these tablets are colored blue or red, but it is best to choose the white ones as they do not contain dye that might tint the paper. This solution should not be used with steel drawing instruments as it corrodes them.

—FRED W. SALMON,
Providence, R. I.

Salesmen's Design Suggestions

To the Editor:

IN SPITE of the fact that in practice one rarely finds the custom of allowing salesmen a word in the design of a product, it certainly would save much time and money if this were done. In many cases it is found that the salesman does not have sufficient technical knowledge to qualify him as a critic, and for this reason the management evidently prefers to place its entire confidence in the designers. This attitude is fallacious, as it is not always knowledge of technical matters that is required.

Salesmen are not interested in drawings as such, but in the change of function or action that will take place in the product which they have to market. The practice of encouraging salesmen to suggest the outline of an alteration or a new machine should be adopted as, by virtue of the fact that they are always in the field, they are well qualified for this work. They are in a unique position not only to discover what competitors are doing, but, what is more important, to get first-hand information of what a customer wants.

—H. LACKMAN,
Philadelphia

Complete Assembly Drawings

To the Editor:

INDIVIDUAL parts of a design should be detailed clearly so that the men in the shop will know exactly what is wanted. But no less stress should be put on the matter of making clear assembly drawings.

Many designers and draftsmen seem to think that every phase of a design must be put in the conventional three views and every line, hole, projection, or screw that is "visible" in orthographic projection must be put in the particular view in which it can be seen. The result often is a drawing that appears like the track layout of a first-class railroad switching yard. Often, a very few lines off to one side of the sheet showing a certain feature in section will save yards and yards of dotted line.

—EDWARD HELLER,
Cleveland.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

THE Willians Premium gold medal, a distinguished engineering honor, has been awarded Francis Hodgkinson, consulting mechanical engineer, Westinghouse Electric & Mfg. Co., South Philadelphia, Pa., by the Institution of Mechanical Engineers, London. This award was given for the best paper published in the Proceedings of the Institute for 1925 to 1930 inclusive. Mr. Hodgkinson's contribution was entitled "Journal Bearing Practice."

Mr. Hodgkinson, well known in marine circles for many contributions to improvement and efficiency in steam-propelling machinery and electrical apparatus, formerly was associated with the late Sir Charles Parsons in his early turbine experiments. Following a term with the Chilean navy and engineering work in Peru, he became associated with the Westinghouse company in 1896, at the time of the introduction of the Parson's turbine in this country. On the establishment of the South Philadelphia works in 1916, he was made chief engineer, and in 1926 was appointed consulting mechanical engineer for all branches.

He has been awarded 83 patents, principally in the field of steam turbines, and in 1925 won the Elliott Cresson gold medal of the Franklin institute. He is a member of the American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

ADVANCEMENT of Edward C. Bullard, vice president and director, to the post of general manager of Bullard Co., Bridgeport, Conn., marks the first of the third generation of his family to step into active management of the company founded by his grandfather 51 years ago. Mr. Bullard obtained his higher education in Sheffield Scientific school, Yale university, graduating with high honors.

After leaving college, in 1917, he was employed as a designer of tools and fixtures in the Bullard Engineering Works, Bridgeport, which at that time was manufacturing heavy guns for the United States government. In December, that year, he was transferred to duty in the heavy artillery division, United States army. Later he was transferred to the ordnance department, participating in various phases of the work.

Upon his honorable discharge from governmental service, in 1919, he returned to Bridgeport to enter the employ of Bullard Machine Tool Co. as student engineer. He worked in various departments of the shop until 1923 when he was appointed assistant production manager. In 1926 he was made assistant to the chief mechanical engineer, and at subsequent intervals was elected to the company's board of directors and to the post of vice president. In the meantime, however, 1929, he had been advanced to engineer in charge of research and development.

ENGINEERING phases of casting specifications, particularly those which deal with the adequacy of design, are one of the principal interests of Oliver Smalley, director of the recently created technical department, Gray Iron institute. A graduate metallurgist of Sheffield university and a graduate in technology of London university, Mr. Smalley was for six years connected with Cammell Laird & Co. Ltd., as chief metallurgist and steel expert. Later he was for two years steel and foundry manager, Scott Engineering Co.

For ten years he held various positions including manager of foundries and pig iron department, chief of research and testing, and technical adviser and chief metallurgist with Sir W. G. Armstrong Whitworth & Co. Ltd. He also has been consultant and advisor for several large American organizations.

Mr. Smalley has contributed to many technical and scientific societies, papers on original researches on foundry, chemical and metallurgical subjects. He is silver medallist of the London City and Guilds institute and a diploma member of the Institute of British Foundrymen 1922-1924.

CONTRIBUTIONS to the design of rotating alternating current machinery has won for Dr. William J. Foster, Schenectady, N. Y., the Lamme medal of the American Institute of Electrical Engineers, awarded annually for meritorious achievement in the development of electrical apparatus or machinery. Dr. Foster, consulting engineer, General Electric Co., retired, graduated from Williams college in 1884, and received the degree of Master of Science from

Leaders in Design, Engineering and Research

FRANCIS HODGKINSON

EDWARD C. BULLARD

OLIVER SMALLEY

WILLIAM J. FOSTER

Cornell university in 1891, after spending five years teaching in high schools.

In the summer of 1891, Dr. Foster began his engineering career with General Electric in the Thomson-Houston works, Lynn, Mass. Beginning in 1893 and extending through several years, his association with Dr. Steinmetz was very close. His drafts of test methods involving heat runs, overloads, temperature rises, etc., were submitted through Dr. Steinmetz to the committee on standardization of the A. I. E. E. and adopted as standard. He has had general charge of the electrical designs of alternating current rotating machines during most of his engineering life.

Dr. Foster has contributed important papers to the publications of the A. I. E. E. and other technical journals. He is a Fellow of the American Institute of Electrical Engineers, and a member of the American Association for the Advancement of Science and Phi Beta Kappa.

* * *

George G. Landis, formerly in charge of electrical and mechanical design of motors and arc welders for Lincoln Electric Co., Cleveland, has been advanced to chief engineer. Mr. Landis, a graduate of Ohio State university, entered the employ of General Electric Co., Schenectady, designing small motors. He next became sales engineer for Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Eight years ago he was placed in charge of the Lincoln company's experimental activities.

* * *

J. J. Baum has been appointed head of the development engineering department, Steel Founders' Society of America, New York. Mr. Baum, formerly connected with Ohio Steel Foundry Co., Springfield, O., attended Carnegie Institute of Technology where he specialized in metallurgical engineering.

* * *

Julius Muller, formerly with Henry Vogt Machine Co., is now development engineer for Leeds & Northrup Co., Philadelphia.

* * *

C. G. Wennerstrom, former chief engineer, Foote Bros. Gear & Machine Co., has joined the Universal Gear Corp., Chicago, manufacturers of power transmission equipment.

* * *

F. I. Sheahan has been transferred from the position of chief engineer of the M. H. Detrick Co., Chicago, to San Francisco as Pacific coast manager. C. F. Pollen, formerly in charge of the Pacific coast office, has been returned to Chicago as sales engineer.

* * *

John R. Freeman, internationally known hydraulic engineer, recently on the advisory staff of the national hydraulic laboratory at the bureau of standards, has been elected a member of the scientific advisory board of the outdoor laboratory of the Forshungs-Institute der Wasserbau near Munich, Germany, along with Professor Seifert, director of the Prussian Research Institute for Hydraulics at Berlin.

* * *

Walter Jenkins, formerly of Lockwood Greene Engineers, Inc., of Charlotte, N. C., and New York, has been engaged as engineer of the Rock Hill Printing and Finishing Co., Rock Hill, N. C.

* * *

R. C. Rolfing, vice president of Oliver Farm Equipment Co., Chicago, in charge of engineering and manufacturing, has resigned and will spend several months in travel.

* * *

Thomas Holloway has joined the United Engineering & Foundry Co., Pittsburgh, as gear consultant.

* * *

Clifford W. Smith, has joined the engineering staff of Oakland Motors. Mr. Smith was formerly experimental engineer for Oldsmobile.

* * *

C. I. Preston has become a research engineer with Lawrance Engineering & Research Corp., New York.

* * *

Carl D. Peterson, has joined the Spicer Mfg. Co., Toledo, O., as an executive engineer. Mr. Peterson was formerly chief engineer with Brown-Lipe Gear Co., Syracuse, N. Y.

* * *

L. B. Stillwell, consulting engineer, New York, will be named chairman of the special committee on power at the meeting of the American Engineering council administrative board to be held in Washington, May 15-16.

* * *

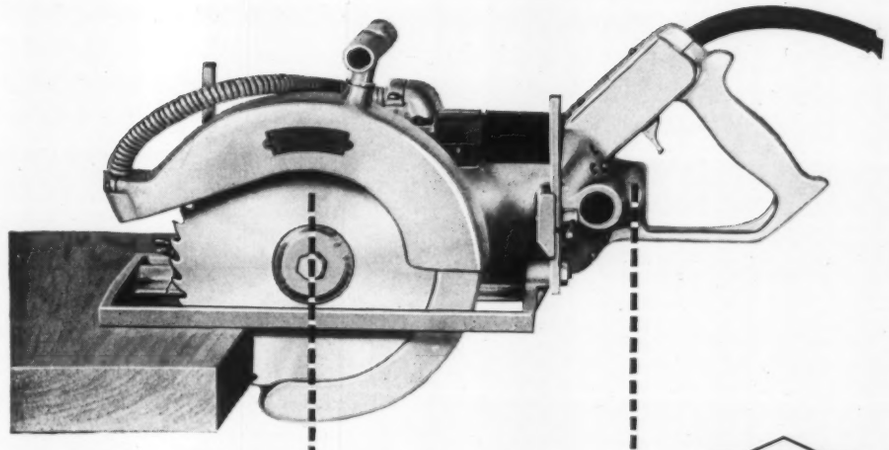
W. W. Nichols, vice president and mechanical engineer of D. P. Brown & Co., Detroit, and Prof. F. G. Novy were decorated with the Order of the White Lion by Dr. Ferdinand Veverka, Czechoslovak minister to Washington.

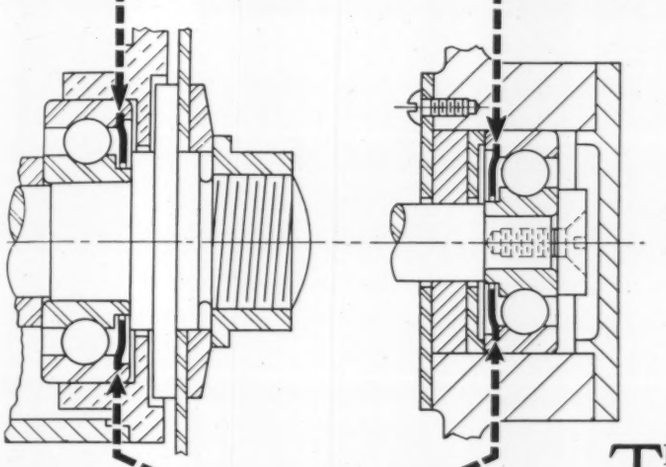
* * *

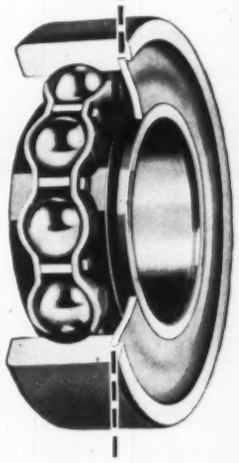
W. H. Lesser, since 1917 mechanical engineer in the operating department of Madeira, Hill & Co.'s anthracite mines, has been appointed combustion and mechanical engineer of the recently organized Penn Anthracite Collieries Co., Scranton, Pa.

* * *

G. H. Garcelon has been appointed manager of the control engineering department of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Garcelon succeeds J. H. Belknap who has been transferred to the engineering division of the Pittsburgh district office of the company.







SRB *Lubri-Seal* Ball Bearings

make this

"PORTO-POWER KING" SAW

GREASE-TIGHT AND DUST-PROOF

THE extra sealing protection that goes with SRB *Lubri-Seal* Ball Bearings, prevents lubrication leakage and dirt intrusion. Thus does the Porto-Power King Saw, shown above, forestall mechanical troubles by using three self-sealed SRB *Lubri-Seal* Ball Bearings on Motor Shaft and Spindle.

The cross-section drawings show clearly how the SRB *Lubri-Seal* has simplified the mounting—eliminated additional sealing arrangements—thereby making it dust and dirt-proof with every assurance that the grease will be retained for positive, long-time lubrication.

"PORTO-POWER KING" Saws are manufactured by Portable Power Tool Corp., Warsaw, Indiana. Also manufacturers of seventeen sizes of Portable Drills—each containing 3 SRB Lubri-Seal Ball Bearings

STANDARD STEEL AND BEARINGS INCORPORATED
Plainville *Connecticut*
DIVISION OF MARLIN-ROCKWELL CORPORATION

Ball SRB Bearings

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

AUTOMATIC chain adjustments are secured by the compact and effective device, patented by Fred C. Thompson, Detroit. The patent, number 1,795,908, is assigned to Morse Chain Co., Ithaca, N. Y. The basis of employment of the mechanism consists of an accessory shaft sprocket, carrying the chain, which will be regarded as travelling clockwise. This sprocket

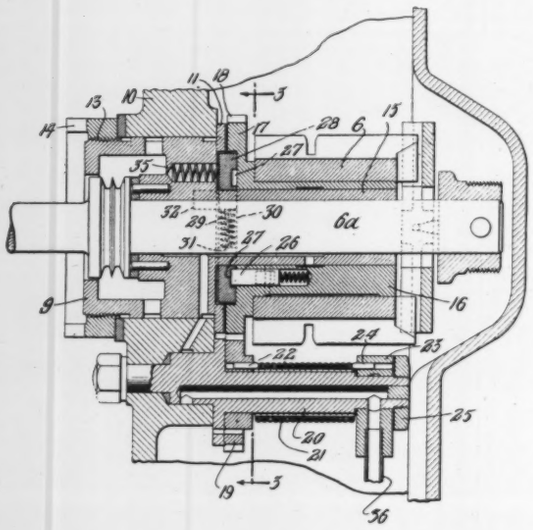


Fig. 1—Chain adjusting device maintains constant tension in drive system

rotates on an eccentric which is rotably mounted on the bearing 9, Fig. 1.

Attached to this bearing is a flanged portion 11, provided for securing it against rotation. It also has a tubular extension 15 bearing on shaft 6*a*. On the extension is rotably mounted the eccentric 16 on which the sprocket wheel revolves. The eccentric has a circular portion 17 coaxial with shaft 6*a*, and teeth 18 extending somewhat over 180 degrees around its periphery. Gear 19, Fig. 2*A* mounted on shaft 20, under the influence of spring 21 rotates in a clockwise direction meshing with teeth 18 and turning the eccentric counterclockwise, taking up the slack by operating through the accessory sprocket. In order to prevent the pull of the chain moving the eccentric back, a latch device holds it in place.

This device, Fig. 2*B*, comprises two spring pressed plungers 26 carried on the eccentric and adapted to snap into notches 27 in the plate located between the eccentric and the bearing. These plungers are so spaced with relation to the notches as to give a fine adjustment with relatively coarse notches. As the eccentric is moved the plungers operate so that any backward thrusts are transmitted to the washer 28 moving it in the direction of the arrow Fig. 2*B*. Such movement is cushioned by spring 29 located in slot 30.

POSITION of a crank pin relative to its axis of revolution may be varied any appreciable distance without interrupting the operation of the mechanism in a mechanical movement invented by Lee B. Green, Lakewood, O. Power is furnished the device through worm 15, Fig. 3, formed upon shaft 16, which meshes with worm wheel 12. This worm wheel is mounted on hub 11 rotating in bearing 10.

Wheel 12 carries crank pin 17 which revolves

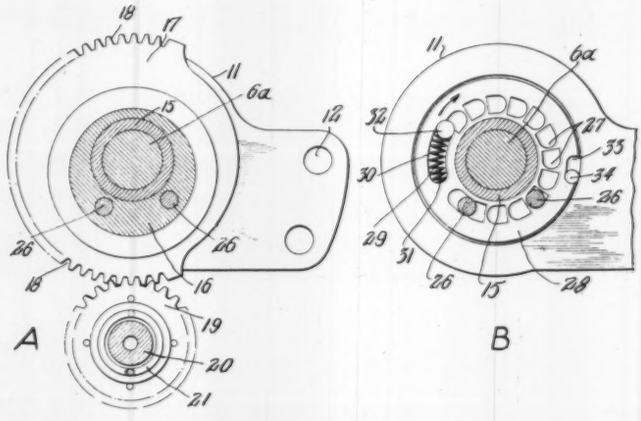


Fig. 2—A—Sectional view of Fig. 1 on line 3—3. B—Latch arrangement holds eccentric in place and cushions backward thrusts

about the center of the wheel and is adapted to transmit power to any suitable connecting rod or similar part. The means employed for shifting the center of crank 17 toward and away from the center of wheel 12 is rod 18 which is slidably mounted in an axial position in hub 11. Longitudinal keyways 19 in rod 18 slidably engaged keys 20 in hub 11. The rod 18 and hub 11 rotate together, but are relatively movable in an axial direction.

On one end rod 18 has pinned a flange collar

Leakproof BECAUSE IT HAS *uniform*, POSITIVE SHAFT *contact*

Uniform pressure at every point of contact is vital to the efficient operation of an oil seal.

That is why our engineers, after hundreds of experiments and laboratory tests, incorporated a specially designed coil spring into the PERFECT OIL RETAINER.

This spring construction holds the scientifically designed leather packing member with exactly the proper tension to effectively retain oil and grease, and to exclude dirt, dust, grit and other injurious abrasives, without binding or causing an objectionable degree of heat.

PERFECT OIL RETAINERS are both efficient and economical. Delivered as a compact, self-contained unit they are quickly installed by a simple press fitting operation. They will effectively seal lubricant leaks and protect the bearings in your product. Our engineers are thoroughly experienced in lubricant sealing problems and will welcome the opportunity to cooperate with you without obligation.

It is of utmost importance that inquiries be accompanied by complete mechanical details such as shaft speeds, heat conditions, type of lubricant, etc.

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Company
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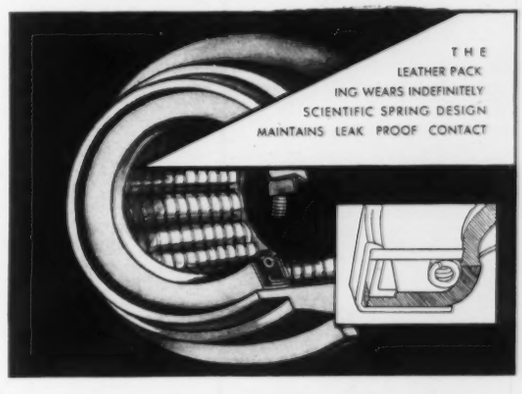
Branches: NEW YORK, DETROIT, CLEVELAND, PHILADELPHIA, PITTSBURGH



IF MADE OF LEATHER FOR MECHANICAL PURPOSES WE MAKE IT

21 by which it may be moved longitudinally. On the opposite end of rod 18 there are a series of spiral teeth 28 which mesh with spiral grooves 29 formed internally in sleeve 30 which surrounds rod 18 and constitutes part of the slide bearing for it. Sleeve 30 is mounted in a smooth bore in the hub 11 concentric with its axis, and is capable of a slight rotation with respect to the hub. This rotation is brought about by the action of teeth 28 in the grooves 29 as the rod 18 is moved lengthwise. Outside the worm 12 the sleeve 30 is provided with external teeth to form pinion 31.

The crank pin 17 is mounted upon the free end of arm 32 which is carried upon shaft 33 that is rotatably mounted in hub 11. Under arm 32 there is an annular flange or collar 34 which engages the end surface of pinion 31 and thereby hold the sleeve 30 against longitudinal movement. Under collar 34 there is pinion 35 which meshes with pinion 31.

By shifting the rod 18 lengthwise a turning movement is imparted to sleeve 30 because of its spiral tooth connection with rod 18. This movement acts through pinion 31. As pinion 31 turns it transmits rotation to pinion 35 and shaft 33,

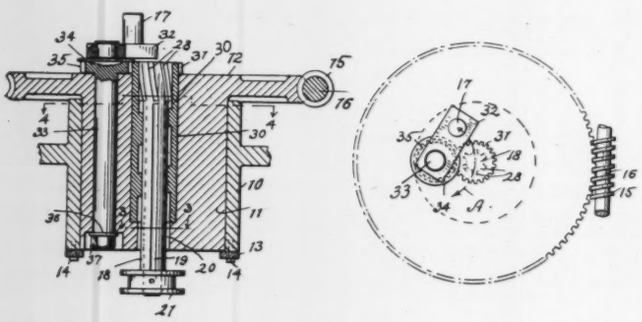


Fig. 3—(Left)—Mechanical movement varies revolution of crank any appreciable distance. (Right)—Plan view of mechanism

thereby swinging arm 32 and causing the crank pin 17 to move through an arc of a circle.

The spiral tooth connection between rod 18 and sleeve 30 may be made steep enough so that any load which may be imposed by the driven mechanism will be insufficient to produce a reverse screw action. The patent, number 1,796,753, has been assigned to Borden Co., Warren, O.

THRUST in both directions as well as the support of radial loads is provided for efficiently in a self-aligning bearing recently patented by Tracy V. Buckwalter, Canton, O., number 1,795,471. In the patent, assigned to Timken Roller Bearing Co., Canton, O., mounted on an inner bearing member 1, Fig. 4, having a raceway 2 that has a spherical curvature lengthwise are two circular series of bearing rollers 3 of tapering form.

The middle portions 4 of the rollers are concavely curved lengthwise and rest on the inner member. Preferably the radius of curvature 5 is slightly less than the radius of curvature 6 of the rollers; so that the rollers have limited contact. The conical end portions 9 of the roll-

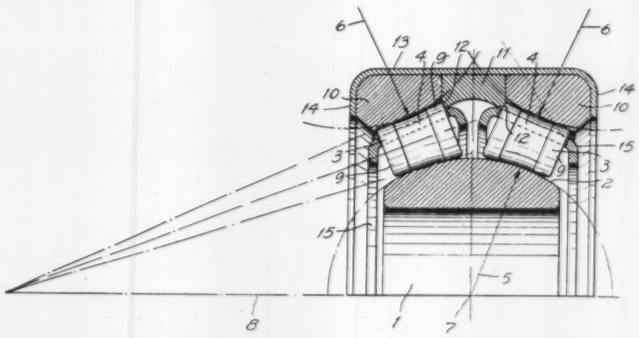


Fig. 4—Self-aligning bearing is protected against thrust from both directions

ers engage conical bearing cups 10. Interposed between cup members is a ring 11 that has beveled edge portions 12 forming thrust ribs against which the large ends of the rollers abut.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

ALLOY—1,800,691. An alloy consisting of 90 per cent by weight of molybdenum, 9 per cent by weight of tungsten, and 1 per cent by weight of chromium. Assigned to Sirian Wire & Contact Co., Newark, N. J.

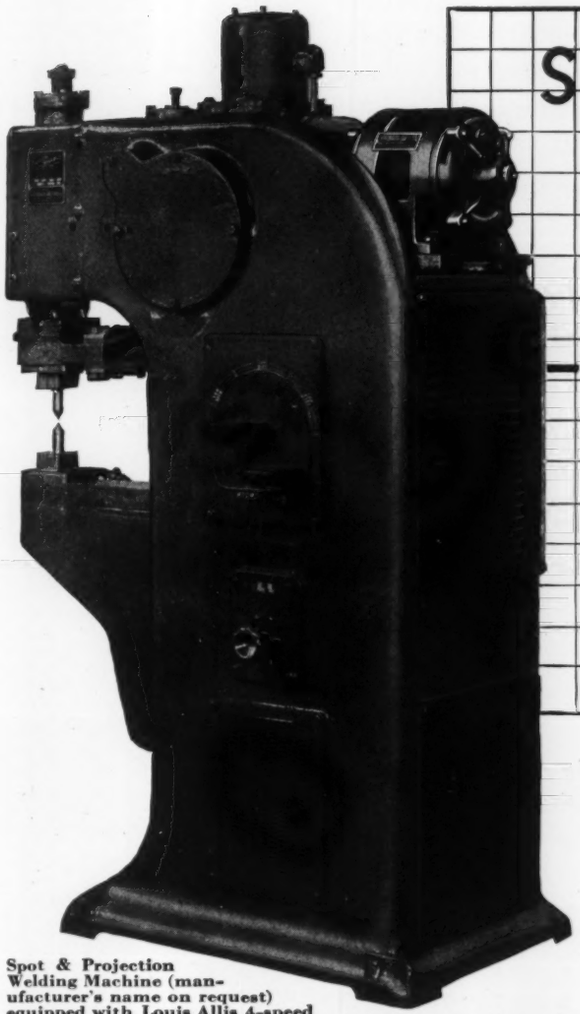
RATCHET WHEEL—1,800,945. A ratchet wheel having two deep notches, affording relatively long teeth, with intervening shallow notches, affording relatively short teeth, one of the deep notches being about half the thickness of the wheel. Assigned to Greist Mfg. Co., New Haven, Conn.

MECHANICAL MOVEMENT—1,802,459. A rotatably mounted member, a solenoid coil, a reciprocable plunger, held in one extreme position and axially movable to another extreme position, and means to advance the plunger a partial revolution upon energization of the coil. Assigned to Lionel Corp., New York.

INDEXING MECHANISM—1,788,423. The combination of an indexible work spindle carrier comprising a front and a rear disk and a spaced intermediate disk, and means co-operating with the intermediate disk for indexing and locking the carrier on automatic multiple-spindle screw machines. Assigned to National Acme Co., Cleveland.

GEAR TOOTH CUTTING—1,788,639. A method of cutting a gear having teeth that are curved endwise across the gear face, consisting in moving a tool in an arcurate path across the gear face. The tool has a straight cutting edge arranged parallel to the axis about which it travels and acting to produce a cylindrical-like surface. Patentee, Harold E. Stonebraker, Rochester, N. Y.

STEPPING UP MACHINE EFFICIENCY with "CUSTOM-BUILT" MOTORS



Spot & Projection Welding Machine (manufacturer's name on request) equipped with Louis Allis 4-speed motor.

4-SPEED Constant Torque Louis Allis ball bearing motor as used on new welding machine here shown. Rating: 2/1⅓/1/⅔ H.P. 1800/1200/900/600 R.P.M. continuous duty.

4-speed motor "tunes" new welder to production needs!

IN selecting Louis Allis 4-speed motors for this new production welding machine, another machine builder has created *definite operating advantages* through *modern* motor application.

The speed of the motor . . . . which actuates the electrode arm through a pinion, worm gear, and cam shaft . . . determines the time intervals at which the electrodes are brought together. Consequently, the use of the 4-speed motor provides 4 definite welding speeds . . . . 30, 45, 60, or 90 welds per minute (or other ranges depending upon the ratio of gears employed) . . . . thus making it possible to properly "tune" production to the variety of work being handled, without troublesome speed-changing gears . . . . an innovation in production welding.

This is a typical example illustrating how Louis Allis "multi-speed" motors . . . . widely used on modern production machines . . . . are STEPPING UP MACHINE EFFICIENCY.

Write for bulletins describing L.A. "Custom-Built" Motors.

Prompt Deliveries **Nation-Wide Service**

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"CUSTOM-BUILT" *Electric* MOTORS

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TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

CREDIT is given to the "hunch," or quick "flash of genius" for the solution of many difficult scientific problems by 200 scientists who recently answered a questionnaire on this subject, sent to them by Prof. R. A. Baker. The results, presented at the annual meeting of the American Chemical society, indicate that fifty-three per cent use devices to create conditions favorable to the "hunch." Proportions of the expedients employed, based on the affirmative answers to the separate questions are: Temporarily abandoning the problem and taking up other work, 60 per cent; a period of complete idleness and relaxation not spent in attacking any other problem, 45 per cent; going over the problem just before retiring for the night, 47 per cent; physical occupation or exercises, 15 per cent; coffee, 42 per cent; tobacco, 14 per cent; and alcohol, 3½ per cent. All agree that there must be a long period of investigation of data and a period of assimilation of the facts before the hunch can be expected to show up.

* * *

Study Causes of Unemployment

TECHNOLOGICAL unemployment is being subjected at the present time to intensive study at Purdue university under the auspices of the American Engineering council, Washington. The inquiry, dealing with the displacement of workers by machines, aims to measure the influence of science and invention on the business cycle, and to point the way to economic adjustments conforming to the conditions created by the machine age.

How far machinery is responsible for swelling the ranks of the idle is a problem which must be solved by a disclosure of the actual facts, engineers say. Up to now there has been much theorizing on this subject, but authoritative information, to promote the general attack on the causes of recurrent cycles of depression, is lacking.

* * *

To Publish Technical Treatises

PUBLICATION of a series of technical treatises to be known as "Engineering Societies Monographs," is to be undertaken by the Engineering Societies Libraries, New York. Editorial supervision of this series will be in the hands of a committee consisting of Harrison W. Craver, director of the library, chairman, and two representatives of each of the four founder societies.

The monographs will give in book form those important technical manuscripts which have proved too extensive on the one hand, for publication in the periodicals or proceedings of engineering societies, and of too specialized a character, on the other hand, to justify ordinary commercial publication in book form. The first volume projected for the series is "Plasticity," by Dr. A. Nadai, Westinghouse Research Laboratories. It will be an adapted and revised translation of Dr. Nadai's German treatise.

* * *

Flexibility Features Vending Machines

ANYTHING from a single hairpin to a half-pound box of chocolates can be accomodated in the magazines of the new adjustable automatic coin machines exhibited recently by the Vending Machine Manufacturers association in New York. Designers are solving the problem of a flexible machine—one that can be adjusted to different sizes of packages. A further problem in the construction of these machines is the automatic handling of liquids, and products which may be smashed if treated too roughly. Other developments are the inclusion of integral mechanism that will make change promptly, retaining only the portion of the original coin needed, and devices that will expel automatically any slugs that may be inserted.

* * *

Discussions Center on Transmission Redesign

TRANSMISSION redesign has inaugurated the most violent discussions, the most bitter criticism, and the most enthusiastic indorsement of any automotive trend of the past year according to D. G. Roos, chief engineer, Studebaker Corp., who recently addressed the Indiana section, Society of Automotive Engineers. Mr. Roos believes this is a healthy state of affairs. He hopes there will be more front drive cars, that cars will be built with the engines in the rear and that other radical designs that are being talked about will come out, so that de-

ON THE 7 SEAS

NICKEL-COPPER ALLOYS

prolong the life of

CONDENSER TUBES

SINCE the early days of steam power, the rapid corrosion of condenser tubes subjected to salt water has been a serious problem.

However, Nickel alloys—because of their exceptional resistance to corrosion at high pressures and temperatures—have come to the rescue . . . have lengthened the service life of condenser tubes, reduced overhaul costs, and actually paid their own way. As a result, the admiralties of seven foreign countries, as well as the commercial fleets that ply the seven seas, now make it standard engineering practice to specify Nickel-copper alloys for condenser tubes.

When added to copper (or brass, bronze, cast iron, steel, stainless steel or aluminum), Nickel imparts one or more of these desirable properties: (1) corrosion and wear-resistance; (2) grain refinement; (3) increased strength and toughness; (4) increased hardness.

All over the world, Nickel alloys help solve troublesome engineering problems . . . because they "perform better longer".

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signers will get away from the deadening sameness that has been felt. Such a departure from sameness is evident in transmissions. Twenty chassis models have four speeds, 63 show three-speed gearsets, 1 has free wheeling on all gears, 10 have free wheeling on high and second, and 10 have a syncro-mesh.

* * *

Announce Farm Machine Design Competition

WANTED, a new farm machine. The class of implement is not particularly important, as long as the equipment is entirely new or a radical improvement on some existing machine and is suitable for use on Scottish farms. With a view to obtaining such a machine the Highland Agricultural society, Edinburgh, Scotland, has offered a prize of £1,000. However, inventors and manufacturers of the United States are barred, unfortunately, competition being restricted to implements manufactured in Great Britain. With such a competition, the present day models of agricultural equipment well might be antiquated in a few years.

* * *

Exposition Supplements Three-M Congress

REFINEMENTS in power application and a tendency toward greater compactness characterized the materials handling equipment exposition held in connection with the recent Three-M congress in Cleveland. Designers also found interest in the various papers presented, among which was one on types of materials used in handling equipment. The author, Hervey J. Skinner, president of Skinner & Sherman Inc., Boston, described a wide variety of materials including a number of alloys.

Among papers applying specifically to engineering departments was "Production Management Applied to the Drafting Department," presented by William J. Kunz, manager of drafting and engineering production, Combustion Engineering Corp., New York. In describing the set-up of the engineering department in his organization he outlined the three divisions, each of which is divided into squads working on specific types of equipment.

Another paper on this phase of improving drafting room management was read by F. D. Newbury. It is abstracted on page 46 of this issue of MACHINE DESIGN.

* * *

Study Fundamental Spring Problems

DEVELOPMENT of an improved code of spring design; investigation of comparative fatigue values of commonly used spring materials; and the establishment of practical "end point" requirements are to be the major interests of the special research committee on mechanical springs of the American Society of Mechanical Engineers. In order to bring the committee's present experimental work closer in line with the practical needs of spring designers, a survey of present industrial practice now is being completed. As a result of intensive research carried out by Prof. M. F. Sayre at Union college, Prof. J. B. Reynolds at Lehigh university, and Dr. D. J. McAdam at the Naval Experiment station, a considerable amount of information has been compiled. The next step is to correlate this data with design practice and to determine the application of the facts brought out to practical problems.

* * *

Textile Industry Improves Machine Operation

FLEXIBILITY, increased operating speeds, attachments to permit the use of more colors, and devices enabling manufacturers to produce more intricate designs were the outstanding developments in the textile machinery field as illustrated at the Knitting Arts exhibition in Philadelphia. In new hosiery equipment considerable interest was attracted by several wrap-stripe machines. One of these was equipped with a 24-move horizontal striper and was used for knitting anklets with the pattern in the foot as well as in the cuff. In accessory equipment for knitting mills was shown a new looper for attaching cuffs and tails to sweaters with the looper points mounted in cylinders instead of rings. Other new equipment included a machine for making and repairing the straps of full-fashioned hosiery machines by inserting in one operation small smooth rivets or eyelets in one, two, or three thickness of fabric.

* * *

Sites Are Chosen for Atmospheric Tests

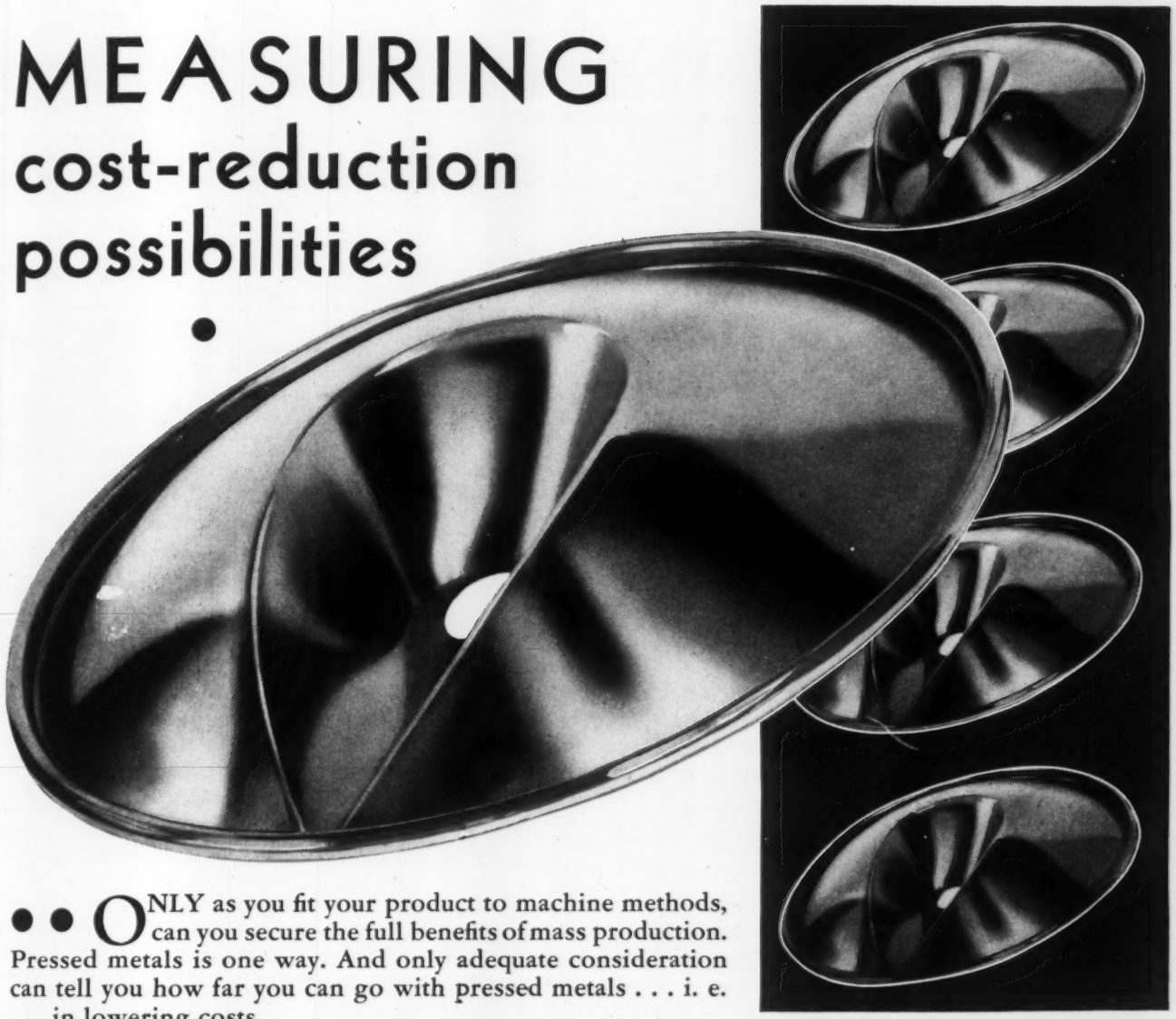
EXTENSIVE atmospheric exposure tests of nonferrous metals and alloys are being conducted by subcommittee VI of committee B-3 of the American Society for Testing Materials. Two new locations in the Far West have been added, providing a dry atmosphere and a peculiarly corrosive region. Test fences stationed in these localities are expected to yield important data. In all, nine test sites have been chosen.

* * *

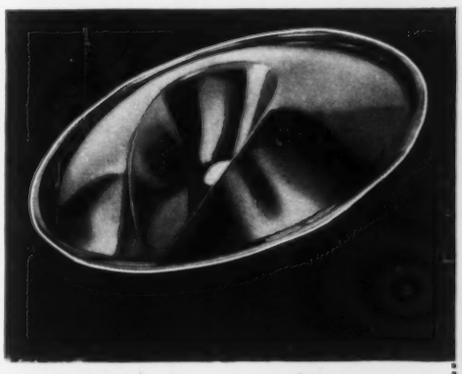
Announce New Industrial Standards

APPROVAL of 46 new national industrial standards including many important projects in all fields of engineering is announced in *American Standards Yearbook for* 1931 just published by the American Standards association, New York. In the foreword to the book, which reviews developments in national and international standardization during the past year, Charles F. Kettering, president, General Motors Research Corp., declares that the lack of co-ordinated functioning within industries and between industries is a major cause of business fluctuations and states that the national standardization movement is making a definite forward step toward the correction of this situation.

MEASURING cost-reduction possibilities



The skill of G. P. & F. Engineers is reflected in the designing of this washing machine cover. It is 21 inches in diameter and presents an interesting study in stamped and drawn one-piece design.



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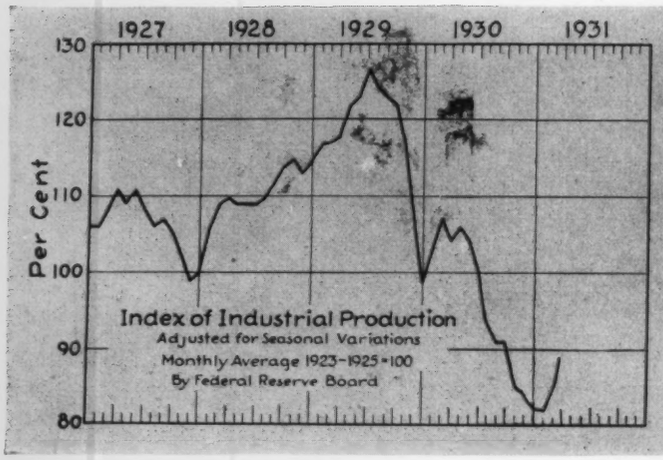
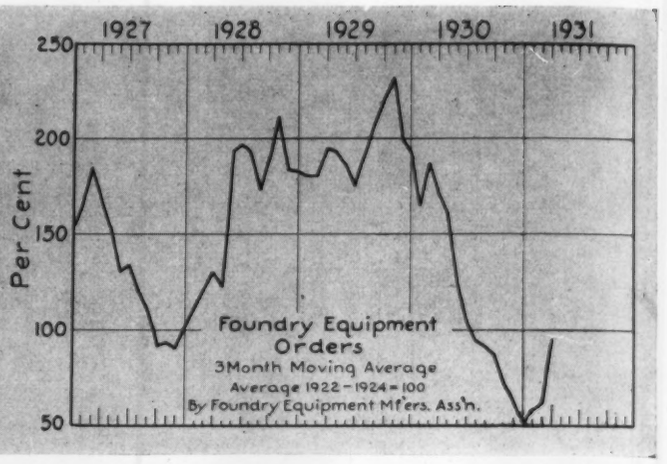
A-4457



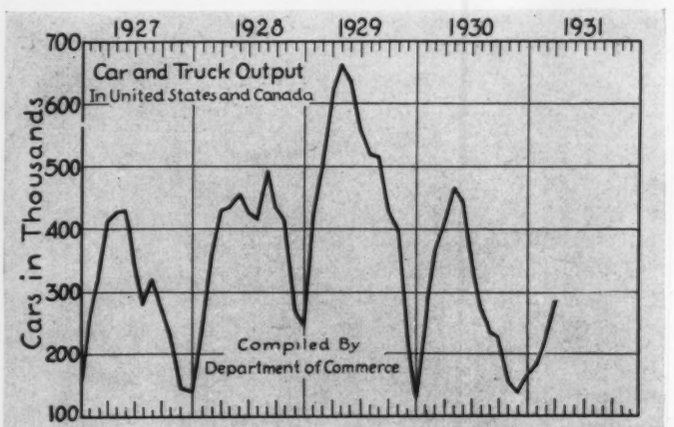


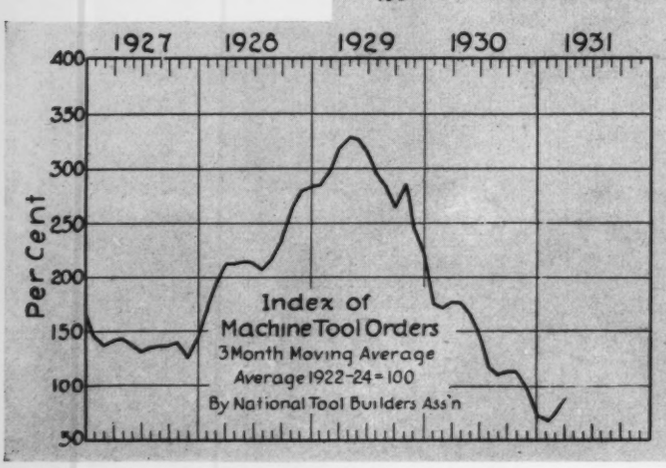
How Is Business?

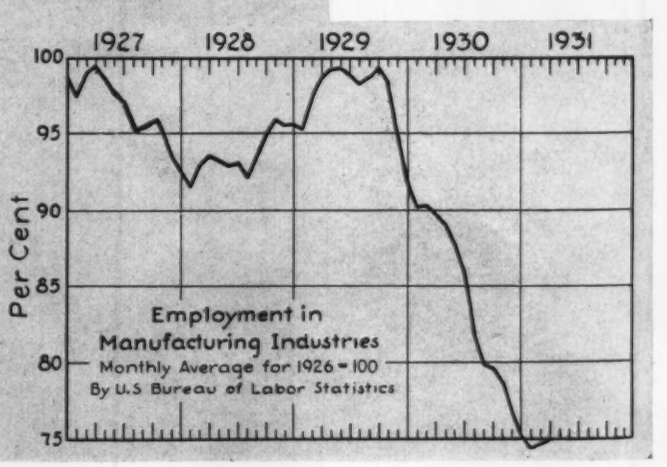
AFTER a year of disappointing business the foundry industry is at last looking upward. The index of gross orders for foundry equipment for March jumped from 54.7 to 174.4, while the three month moving average showed almost a 50 per cent gain over February.

Coupled with this, members of the Steel Founders society report prospects for a continued advance to be fair to good. The Gray Iron institute also reports that March business of its members increased for the third consecutive month. This group believes the business outlook for the next few months to be good. These indications of improved foundry trade mean that the designs which have been simmering on the board for months have at last found their way into production, and that orders for materials and parts should reflect this condition.

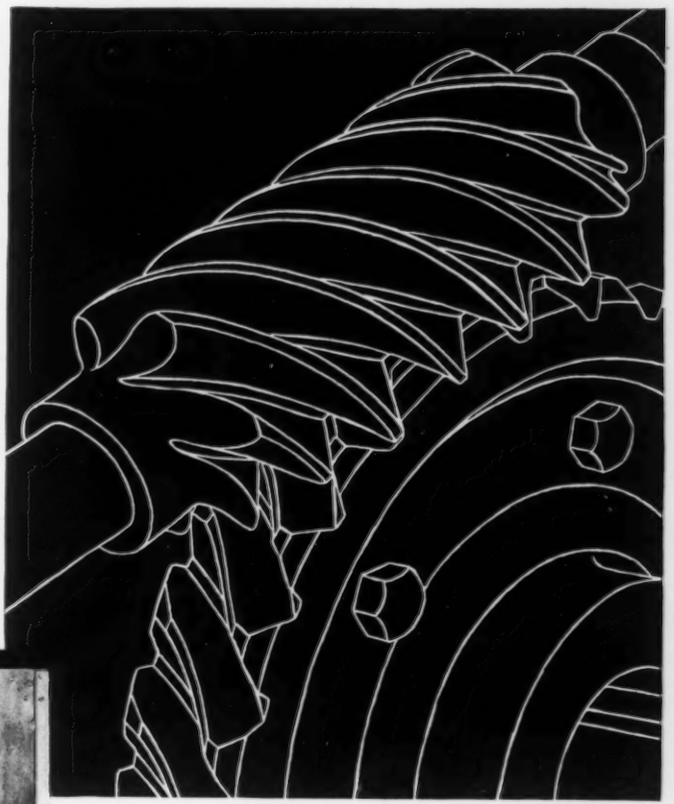
Despite these encouraging factors, the machine tool industry does not believe that there is enough business in sight to justify hope of large activity before Fall, discounting the current increase on the basis of seasonal activity. Nevertheless, increases in steel ingot output and blast furnace operations have been sufficient to give hope of slowly increasing activity until major advances take place. That seasonal activity is making itself felt is encouraging, especially in view of the pessimistic predictions that even this factor would not alter the situation. This trend is also reflected by payroll increases which indicate improvements in hours of work.







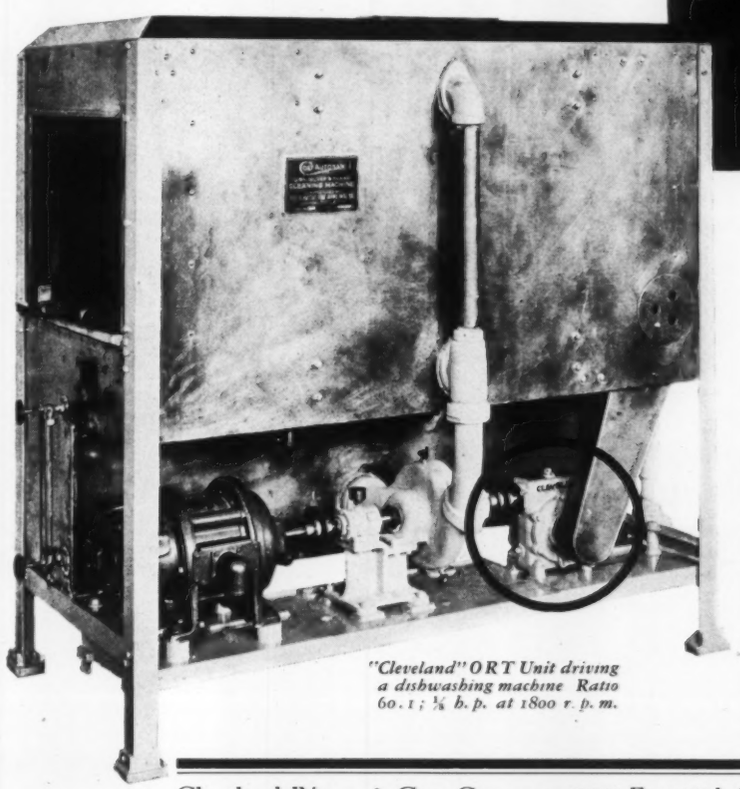
Designers specify this speed reducer because it's so *adaptable* . . . . .



It matters not whether your design calls for a horizontal drive, vertical drive or power transmission at right angles to the driven machine, "Cleveland" adaptability permits a reducer that will meet your needs.

Compact, sturdy and highly efficient, no other type of speed reducer has so few moving parts as the Cleveland Worm Drive—no other type gives such a great variety of reductions in so small an amount of space.

Forty-eight standard sizes and types of "Clevelands" . . . ratios from 3-5/9:1 to 10,000:1 . . . power capacities up to 200 h. p.



"Cleveland" O R T Unit driving a dishwashing machine Ratio 60.1; ⅛ h. p. at 1800 r. p. m.

. . . speeds up to 4,000 r.p.m. enable you to select a *standard* Cleveland unit for any but extraordinary requirements.

"Cleveland" Engineers are ready to lend you valuable co-operation in speed reducer application. Ask us at any time for special help and make sure that you have "Cleveland" Bulletins 108 and 110 in your file by returning the coupon below.

CLEVELAND
WORM & GEAR COMPANY
3275 EAST 80TH STREET . . CLEVELAND, OHIO
CLEVELAND WORM GEARING . . THE ULTIMATE DRIVE

Cleveland Worm & Gear Company, 3275 East 80th St., Cleveland, Ohio
Please send Bulletins 108 and 110 on Cleveland Worm Gear Speed Reducers.

Name_____ Company Name_____

Address_____

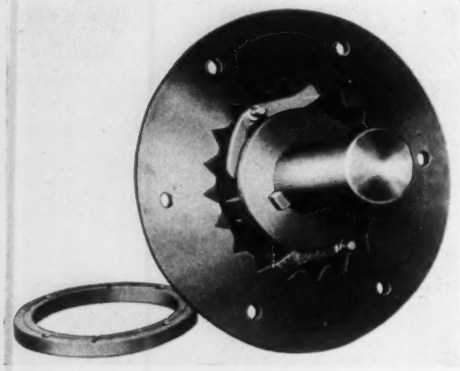
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Back Stops Serve as Bearings

POSITIVE means of preventing shaft reversal is possible by use of the Landahl life-time back stop recently placed on the market by Fairfield Engineering Co., Marion, O. Its action is applied in such a manner that no impact needs to be overcome, and it operates automatically. Construction of the back stop is such that it serves also as a bearing and thus requires no extra shaft space. It eliminates shaft end thrust in either direction so that no separate set collars are required. Internal construction consists of two locking pawls mounted on pins held by two floating rings and a pawl collar.

All of the parts rotate as a unit by engagement of the pawls with the pawl collar. This pawl collar is shaped so that the pawls do not engage the ratchet as long as the shaft is traveling in the correct direction, but lock in the ratchet immediately the shaft direction reverses. The pawl collar is fastened rigidly to the shaft

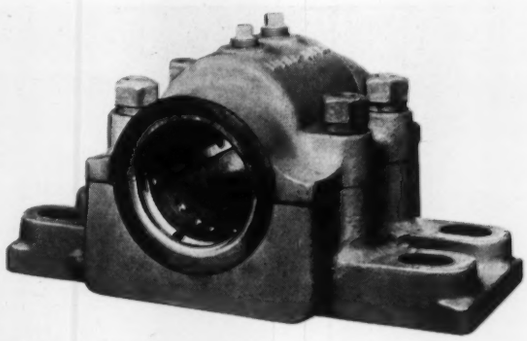


Back stop serves as bearing and prevents shaft reversals

both by a key and a set screw. The floating rings are seated in the ratchet housing but are free to rotate with the pawls and pawl collar. The back stop is shown in the illustration.

Constant Lubrication Is Provided

INCORPORATION of a circulating system which maintains a constant and uniform microscopic film of oil between the shaft and the bearing metal features the design of a new bearing manufactured by Robins Conveying Belt Co., New York. This equipment, known as the Robins-Jones bearing, shown in the accompanying illustration, differs little in outward appearance from ordinary bearings, but internally there is a marked change. In the base is provided an oil reservoir from which the oil is



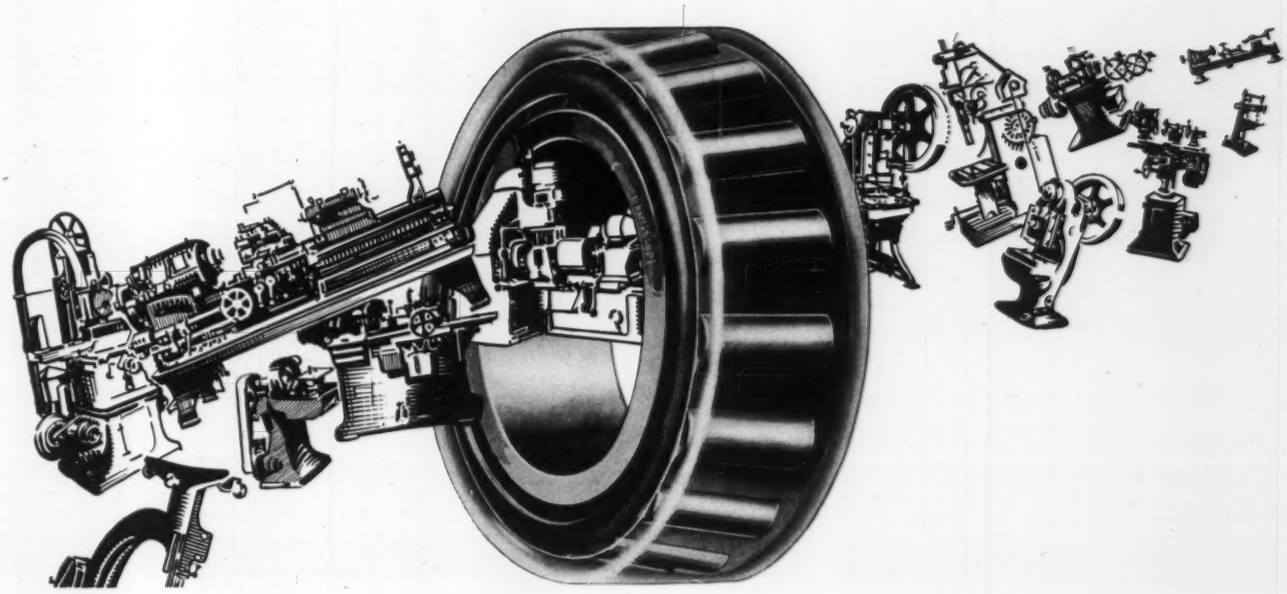
Oil is circulated constantly around the shaft in bearing shown

drawn up by the rotation of the shaft through a series of ducts or passageways in the bearing metal to the point on the bearing of greatest pressure. From this point, or rather line, the oil is spread over the whole shaft.

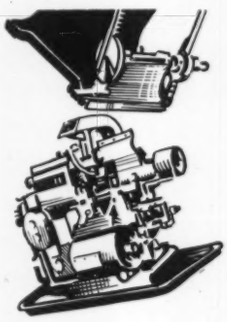
At the parting of the cap and base, there are slots from which scavenger holes return excess oil to the reservoir. Grooves near each end of the bearing prevent leakage and lead the oil that works out to the ends back into the reservoir. The shaft may be rotated in either direction and the bearing may be applied to vertical as well as horizontal shafts. It can take load or pressure from any direction since the cap, which also has a reservoir and ducts, functions similarly to the lower part.

Eliminate Roller Retaining Ring

ABSENCE of a cage or retaining ring is the principal feature of the new line of tapered roller bearings now in production by the Tyson Roller Bearing Corp., Massillon, O. Positive roll alignment is attained by the use of a double ribbed backplate at the big end of the rolls. The shoulder of each roll gets a bearing on the in-



Timken-equipped machines keep pace with Progress



Tapered Roller TIMKEN BEARING EQUIPPED

Thousands of production machines built but a few years ago are obsolescent today. They cannot keep pace with advancing production standards. Will that be the fate of the machines you are designing now?

Machinery buyers are looking ahead with keener vision than ever before... exercising more care in the selection of new equipment... seeking to protect themselves against the threat of early obsolescence.

The presence of Timken Bearings on spindles and at all vital points of friction and hard service is one important guide they are using.

For Timkens are more than wear preventers and power savers. Through Timken tapered construction, Timken positively aligned rolls and Timken-made steel, they carry all loads—all radial, all thrust or both together in any combination—fortify the entire mechanism against time and continuous hard use.

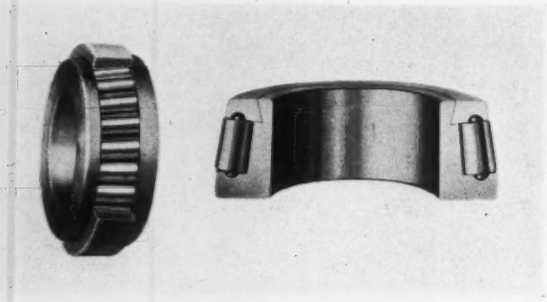
Depreciation is deferred. Obsolescence is postponed. Production is protected. Machine investment is safeguarded. Give users of your machines these Timken benefits in full.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

side rib of the backplate, as in conventional tapered roller bearings, but it also gets an additional bearing on the outside rib. Thus, with double contact on the thrust end of each roll, positive alignment, both longitudinally and vertically is secured. Pintles at both ends of the rolls extending into annular grooves in the backplate and closing ring hold the rolls in place when the cup is removed.

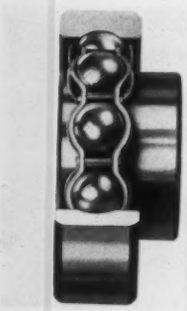


Elimination of retaining cage features roller bearing

The bearings, shown in the accompanying illustration, are made in all S. A. E. sizes and are interchangeable for all types of antifriction bearing installations. Accepted standardization of all industrial and automotive applications have been adhered to, and the bearings may be adjusted by the methods now in common use.

Bearing Embodies Wide Inner Ring

LOCK nuts are eliminated in the design of the line of SRB wide-inner bearings announced recently by Standard Steel and Bearings Inc., Plainville, Conn. These single-row bearings, shown in the accompanying illustration, are of the same design and dimensions as the SRB maximum capacity bearings except that the inner ring is of the same width as that of double-row bearings of corresponding sizes. Electric motors and other applications where only a locating or nominal thrust is present are the principal uses of the new equipment.



Bearings have wide inner ring

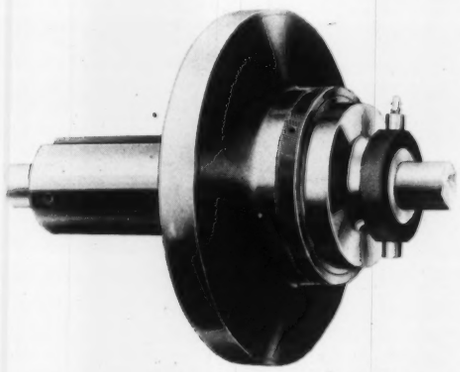
Announce Heavy-Duty Bearings

BUSHINGS and bearings made of new superhard low friction bronze alloys are announced by Bunting Brass & Bronze Co., Toledo, O. This new product meets the need of mechanical industry for a bearing for applications where hardness and ability to withstand pounding are desired, together with the low friction and minimum wear assured by a leaded phosphor bronze alloy. Such bearing requirements are especially a problem in applications subject to shock loads, high speeds and other severe conditions.

The lead content in the bearings can be varied from 5 to 25 per cent, depending on the type of service required. It offers physical properties superior to the higher friction bronzes containing little or no lead which heretofore have commonly been specified due to their ability to withstand heavy pressure and shock loads.

Clutch Has Large Friction Area

LARGE friction area insuring development of rated horsepower under practical unit pressure is available in a new friction clutch introduced recently by Dodge Mfg. Corp., Mishawaka, Ind., for machinery applications and power transmission service. The clutch, shown in the accompanying illustration, has asbestos friction disks with ground faces. It is fully enclosed in both engaged and disengaged positions providing complete safety, as well as protection against dust and dirt.



Asbestos friction disks enable clutch to give rated horsepower

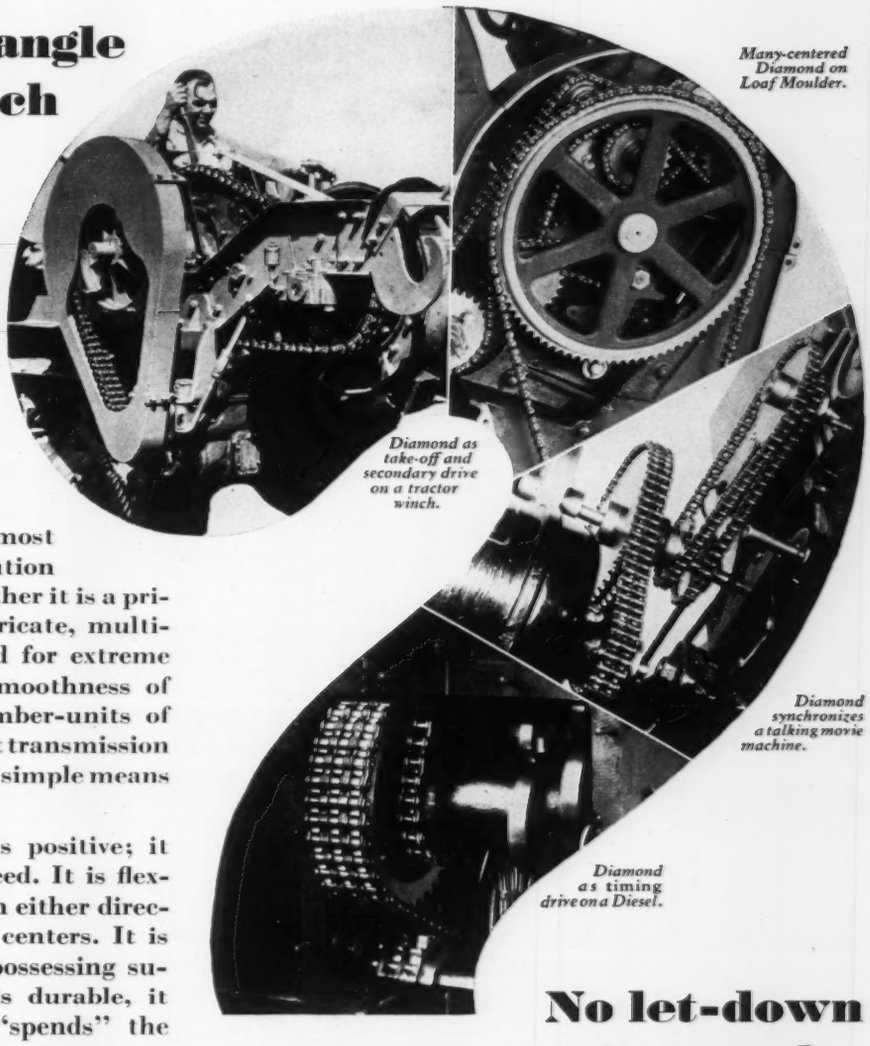
An exceptionally heavy-duty slip ring, which is easy to lubricate and can be furnished in either bronze or ball bearing types is used in the clutch. The movement of this slip ring is positive and is not affected by wear of friction material or adjustment of clutch. Easy and positive engagement and disengagement is developed by a self-locking toggle mechanism. One point adjustment is provided.

Switches Withstand Severe Service

JOGGING or similar severe service conditions are accommodated easily in the new motor starting switches, type T.M.2, designed recently by Trumbull Electric Mfg. Co., Plainville, Conn. These switches, shown in the accompany-

From whatever angle you must approach your problem—

the *Diamond Drive* FITS



Many-centered Diamond on Loaf Moulder.

Diamond as take-off and secondary drive on a tractor winch.

Diamond synchronizes a talking movie machine.

Diamond as timing drive on a Diesel.

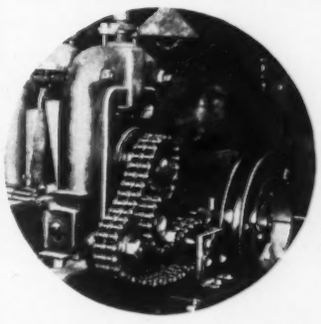
DIAMOND Roller Chain in most cases provides a ready solution of your design problem . . . whether it is a primary drive in question; an intricate, multi-centered application; or a need for extreme accuracy and precision, and smoothness of transmission. Even where member-units of your assembly obstruct the direct transmission path, Diamond Chain provides a simple means of "hooking up."

The Diamond Chain Drive is positive; it maintains the same rate of speed. It is flexible, can be run on either side, in either direction, over and under multiple centers. It is light in weight, compact, yet possessing superior strength. Above all it is durable, it requires the least attention, "spends" the least money, of any type of transmission.

There are 8 classes of application wherein Diamond Roller Chain is of immense importance to the thoughtful machine designer. These classes are fully described in the new edition of booklet 104A, "*Simplifying and Improving Machine Design.*"

DIAMOND CHAIN & MFG. CO.
435 Kentucky Avenue Indianapolis, Ind.
Offices and Agents in Principal Cities

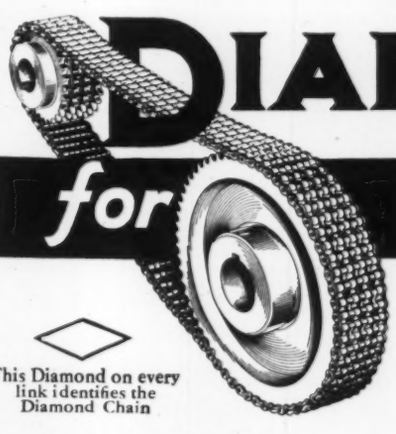
No let-down in speed after years of use



Diamond driving a 6" cold-rolling machine.

DIAMOND ◇ DRIVES

for Every Industrial Need

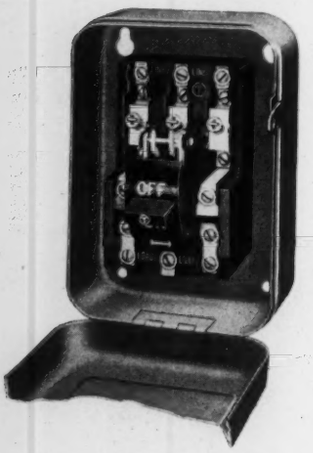


This Diamond on every link identifies the Diamond Chain

DIAMOND CHAIN & MFG. CO., 435 Kentucky Avenue, Indianapolis, Ind.
Gentlemen: Please send me a copy of Booklet 104A, "*Simplifying and Improving Machine Design.*"
Name.....
Firm.....
Address.....
City..... State.....

(A-4163)

ing illustration, will break stalled rotor currents of motors in excess of listed ratings. Overload protection is provided by heater units which are interchanged readily from the front of the switch. The equipment is available in alternating current styles from 110 to 550 volts. Ratings for polyphase types are two horsepower for

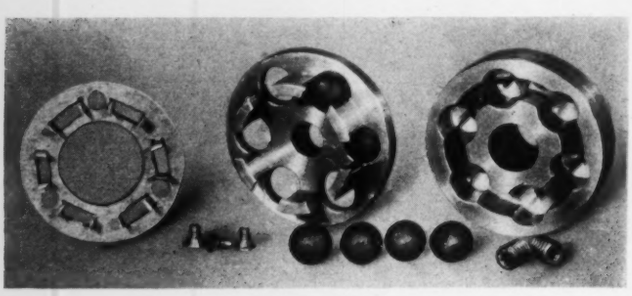


Starting switches are built for heavy duty work and to overcome severe service conditions

all voltages, while the single phase type has ratings of 1 horsepower at 110 volts and two horsepower for all other sizes.

Coupling Absorbs Sudden Shocks

MAXIMUM torsional resilience and high shock absorbing qualities are provided in the design of the Edmunds flexible coupling announced recently by Crocker-Wheeler Mfg. Co., Ampere, N. J. The flange half of this coupling, shown in the accompanying illustration, has six cylindrical pockets, all parallel to the shaft, with circular grooves in the spaces between the pockets. The other half, called the spider, has six projecting lugs between which are placed shock absorbing rubber balls. When assembled the balls occupy the pockets in the flange, and as the transmitted torque varies, the lugs on the spider squeeze the balls, thereby taking up the shock, regardless of direction of rotation. An additional feature of this coupling is that by removing the rubber balls, the motor or other driving mechanism can be disconnected from the load.

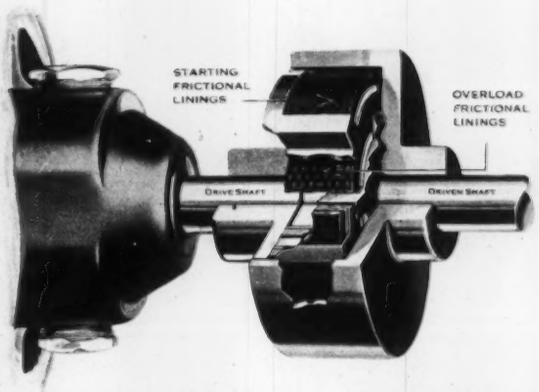


Disassembled view of flexible coupling

Reduces Heavy Starting Loads

REDUCTION of starting loads and absorption of shocks and vibrations is accomplished with the automatic starter and flexible coupling introduced by Washburn Shops, Worcester Polytechnic institute, Worcester, Mass. The device, shown in the accompanying illustration, consists of two cast iron members, one attached to the driving shaft, and the other to the driven shaft. Between the driving and driven members are inserted floating segments made of brake lining reinforced with lead.

With the application of power centrifugal force begins to act on the outer set of linings. There is sufficient lag, however, to allow the driving member to come to full speed before



Coupling allows driving member to come to full speed before starting driven member

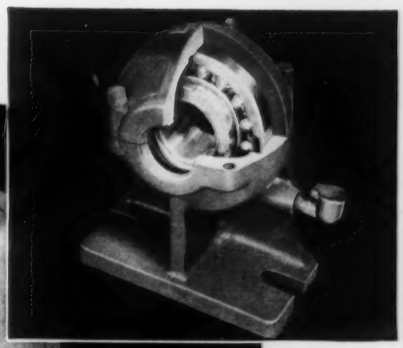
centrifugal pressure takes effect on the driven member. In order to overcome generation of heat and to give sufficient overload capacity, a second set of centrifugal friction linings is introduced on the driven side. As soon as the driven side starts to revolve, centrifugal action begins to take place on this side of the starter and the action comes through the second set of friction linings throwing them against the friction surface of the driving side.

Total starter capacity ranges from 10 to 14 horsepower and driven shaft speeds from 300 to 1800 revolutions per minute.

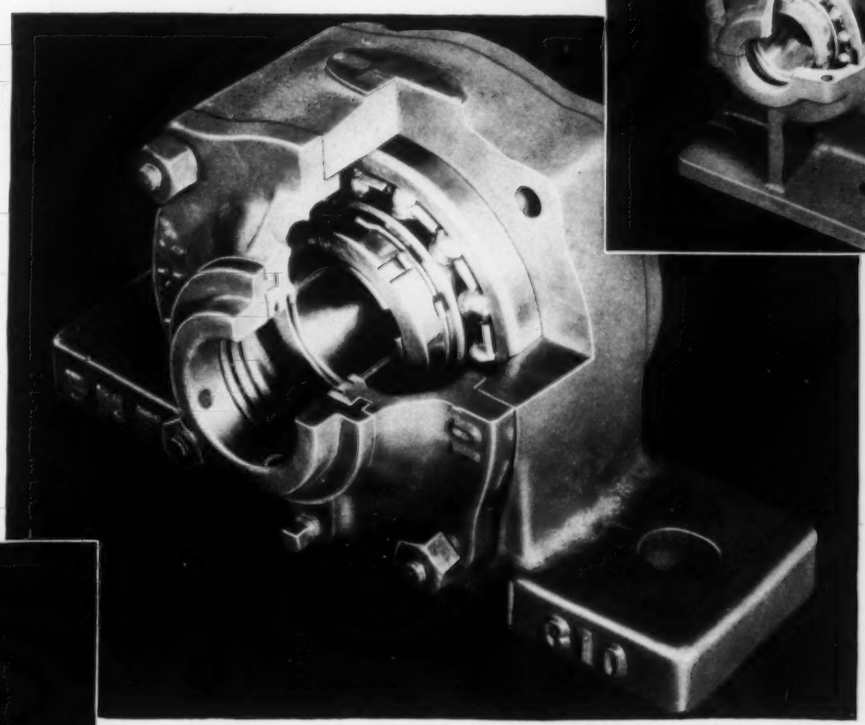
Drive Provides Multiple Speeds

CONSTRUCTED to give four different speeds to the output shaft at constant horsepower, the Westinghouse-Wise multi-speed drive being marketed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is applicable to industrial operations which requires drives providing more

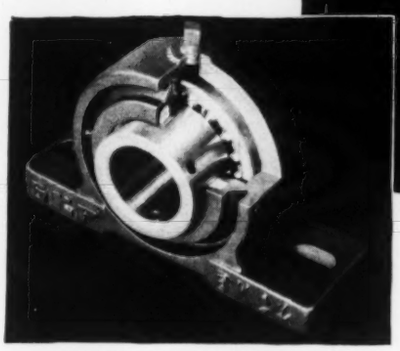
SKF FAN BOX
for universal use on majority of fans and blowers



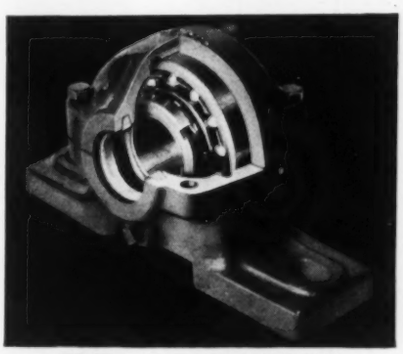
COMPLETE SKF UNITS — BEARINGS AND HOUSINGS



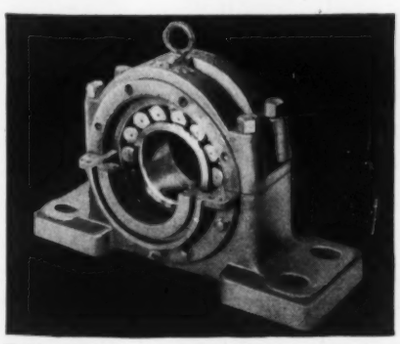
SKF UNIVERSAL PILLOW BLOCK
adaptable for the varying and exacting requirements of machine applications



SKF UNIT PILLOW BLOCK
for applications where simplicity of installation is desired



SKF SPLIT PILLOW BLOCK
for normal and heavy duty standard applications



SKF ROLLER BEARING PILLOW BLOCK
for the most severe applications in industry.

A *NEW* COMPLETE LINE OF SKF PILLOW BLOCKS

COMPLETE bearing units . . . housings and bearings . . . in variety to meet every need and produced up to KNOWN SKF standards of quality.

SKF Pillow Block housings are made with the same attention to essential detail that is characteristic of SKF Anti-Friction Bearing Production.

Designed to meet the lubrication needs of the bearings . . . machined to FIT the bearings to the exacting requirements of good performance . . . these housings, coupled with the bearings, offer you the advantage of a perfectly coordinated bearing unit that will measure up in every way to time-tried standards of performance.

And where performance takes preference over price, there is an SKF Bearing and Housing . . . for every need. Write for more details now.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

2664

SKF

than one speed. With this drive the speed of the driven apparatus may be changed instantly and without injury while the motor is running at full speed or under full load.

This gear unit, shown in the accompanying illustration, is mounted on a standard squirrel cage induction motor. In the unit, a pinion mounted on the motor shaft drives a gear mounted on a countershaft. Also on the countershaft are four idling ring gears which are constantly in mesh with four gears that are pressed on the output shaft. Each of the countershaft gears is provided with an internal clutch which is made to fit the bore of the gear. The clutch is actuated by two tapered wedges which are forced between the clutch halves by a spring member.

To bring this member to the correct position for a desired speed, the control handle, which is provided with a spur pinion, is rotated, actuating a rack which is mounted on the spring member. This movement brings the spring member between the tapered wedges, thereby

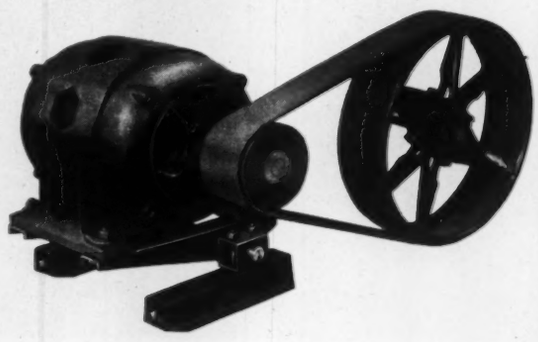
Multiple speeds are available with combined motor and drive

providing the pressure for clutching any one of the four gears on the countershaft, which in turn drives the output shaft. The drive is offered in three units, ranging from ½ to 7½ horsepower.

Maintains Proper Belt Tension

MOTOR torque is utilized to maintain belt tension in the new "floating" motor drive developed by Kritzer Co., Chicago. With this mounting for short center drives, shown in the accompanying illustration, the driving motor is said to float on the load, maintaining just sufficient tension on the belt to carry the load and automatically compensating the normal increase in belt length during operation without the use of idlers.

The basic principle of "every action has a reaction" is the fundamental idea used. In a motor, rotation of the armature provides a "kickback" to the motor frame. If the armature were locked in one position, the frame would revolve in the opposite direction. If the armature were "partially" locked, as with a belt under load, the motor frame would revolve if it were not bolted down. With the pivot mounting shown, this reaction of the motor frame is permitted, by the proper location of the pivot, to increase the belt centers by moving them apart.



Belt tension is maintained by motor torque in "floating" drive

The weight of the motor is balanced and the entire action is due to motor torque.

Develops Rust Proofing Process

DEVELOPMENT of a new basic material to be used in a rust-proofing process has been announced by American Chemical Paint Co., Ambler, Pa. "Paradox," the new material, is a chemicalized enamel or japan designed to be dried by baking at temperatures which are ordinarily used in the enameling and japanning of various sheet metal parts.

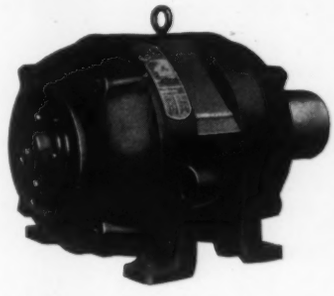
It differs from the ordinary japans or enamels in that it contains ingredients which will remove extremely thin rust coating and counteract the rust-forming properties of the invisible chemicals present on full-finished sheet steel surfaces. In addition the material is said to prevent the development of alkali spots beneath enamel coatings. Paradox is used as an undercoating and is applied directly to the surface of the metal.

Compactness Features New Motors

FRACTIONAL horsepower motors, from 1/10 to 1/3 horsepower, in condenser start, split phase and polyphase types, all built into frames with the same mechanical dimensions, are being marketed by Howell Electric Motors Co., Howell, Mich. The condenser motor, shown in the accompanying illustration, has the condenser mounted in a compact box, on top of the motor, with all connections made inside of the box. These boxes may be detached and mounted at any other point in the vicinity of the installation

All Ball-Bearing Motors are NOT alike . . .

F-M Type QC Ball Bearing Motor. Totally enclosed. Fan cooled. Needs no piping. Widely used on drives where dust, dirt and metallic particles are encountered.



Fairbanks-Morse Type Q Ball Bearing Motor

Today ball bearing motors are made by practically every motor manufacturer. But this does not mean that all ball bearing motors are alike. The invaluable experience gained in eighteen years of painstaking field research is reflected in the outstanding performance that is responsible for Fairbanks-Morse leadership in the ball bearing motor field today.

F-M superiority can be proved by a comparative inspection of these motors and other motors. Check construction details point by point.

Study the advantages of F-M *sealed* bearing construction which *incorporates the highest priced ball bearings in the world.* Then you will understand why the users of F-M Ball Bearing Motors specify them year after year for service that requires maximum dependability and lowest overall operating cost.

FAIRBANKS, MORSE & CO.

900 S. Wabash Ave., Chicago

32 branches at your service throughout the United States

FAIRBANKS-MORSE MOTORS

5508-EA40. 39

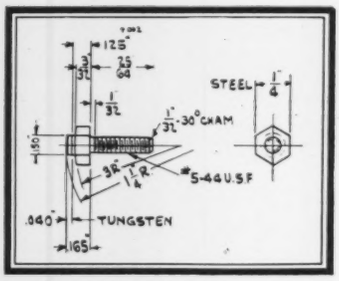
POWER PUMPING AND WEIGHING EQUIPMENT

RARE METALS AND ALLOYS

FANSTEEL

best source of supply for

Contact Points



Design . . . to Finished Product

SO important are contact points in the performance of electrical products that Fansteel delegates responsibility to nobody. Every process from original engineering to the final inspector's last test is carried out *in one plant*, under one scientific control. There can be no "buck passing."

Contact metals are refined from ores and basic salts—rods are sliced into discs with *end grain* wearing surface (this process originated by Fansteel)—screws, rivets or other fixtures are made on Fansteel's own machines—and the laboratory keeps a constant check over every step in every process.

All this is done to build an *assurance of dependability* into your contact points. Fansteel will design and make contacts especially for your product—more often your requirements can be met from our large stock of standard types, at substantial savings in time and in cost.

Your inquiry is invited.

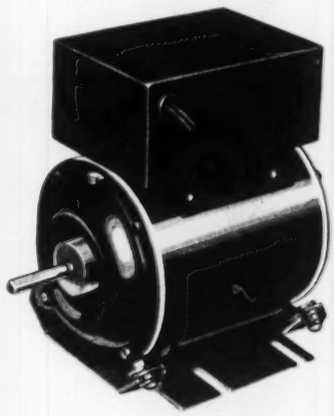
TANTALUM · TUNGSTEN · MOLYBDENUM · CAESIUM · RUBIDIUM

FANSTEEL PRODUCTS COMPANY, Inc.

NORTH CHICAGO, ILLINOIS

that may be desired for convenience or to comply with safety regulations as outlined by underwriters' specifications.

The condenser motors, known as type CL, are high starting torque constant speed motors having at full voltage, a starting torque of from



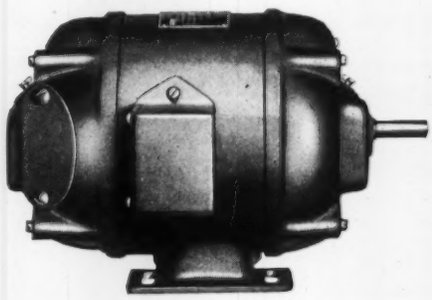
Identical mechanical dimensions feature line of fractional horsepower motors

300 to 400 per cent of full load torque, and a maximum running torque of about 200 per cent of full load.

The split phase motors are built to conform to both the short hour and long hour ratings. They may be equipped with either ball or sleeve waste packed bearings, in the same mechanical dimensions.

Bearing Brackets Protects Motors

UNUSUAL protection against falling objects, dirt, or dripping water is provided by the bearing brackets in the new line of fractional horsepower motors announced by Century Electric Co., St. Louis. The motors, one of which



Motors are protected against falling objects, dirt, dripping water or other injurious forces

is shown in the accompanying illustration, have interchangeable mounting dimensions and are built in repulsion start induction single phase, split phase single phase, squirrel cage induction three phase, and direct current types. They have rolled steel frames, welded steel feet slot-

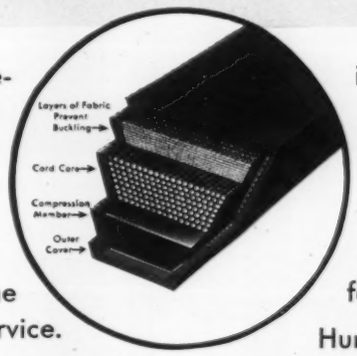
No. 4 of a series of data sheets for the use of engineers in applying Texrope Drives to all classes of equipment.

TEXROPE DRIVES HAVE A LARGE OVERLOAD CAPACITY

The nature of any power load may vary considerably owing to high starting torque, pulsating loads, or frequent overload peaks. It is of extreme importance that proper overload provision be made in the design of power transmission machinery.

Texrope Drive recommendations are based on experiences covering a period of many years, and in collaboration with a large staff of research engineers. To base engineering recommendations for power transmission machinery merely on the horsepower rating of the driving machine would be detrimental. Other factors play an important part if the equipment is to give many years of service.

Applications	*Overload Factors*
Brick and Clay Machinery	1.2 to 1.3
Coal Mining Machinery	1.0 to 1.4
Cotton Ginning Machinery	1.0 to 1.2
Fans and Blowers	1.2 to 1.4
Flour and Feed Mill Machinery	1.2 to 1.3
Laundry Machinery	1.1 to 1.2
Machine Tools	1.0 to 1.3
Metal Mining Machinery	1.0 to 1.4
Oil Field Machinery	1.2 to 1.5
Pulp and Paper Machinery	1.2 to 1.4
Printing Machinery	1.0 to 1.3
Pumps and Compressors	1.2 to 1.3
Rock Crushing Machinery	1.2 to 1.4
Textile Machinery	1.2 to 1.5
Woodworking Machinery	1.2 to 1.3



Provision must be made to take care of the overload that may occur throughout the life of the machine to assure economy and satisfaction.

Allis-Chalmers engineers have studied the various overload conditions that enter into the operation of all classes of driven machines. They have also established certain overload factors to overcome such unusual requirements as reversing service, line-start application, high starting torque, pulsating load or frequent overload peaks.

With the use of these overload factors it is comparatively simple to determine the required normal rating of the drive.

Texrope overload factors for some of the more general applications are given in the accompanying table. Complete engineering data is given in the Allis-Chalmers Tex-Book, a copy of which will be sent on request. A sustained efficiency of 98.9% is achieved with Texrope Drives. Their application is universally successful from ½ to 2,000 H. P. for reductions from 1:1 up to 7:1.

Hundreds of manufacturers have found, in Texrope Drives an effective sales feature ... Over 100,000 Texrope Drives are now in use. They have effected surprisingly large savings in the first cost as well as reduced operating costs.

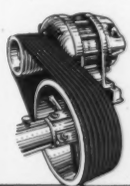
Send for the Allis-Chalmers Tex-Book and a copy of Bulletin 1228-K, showing over 70 Texrope installations. If you are interested in machine tool applications Bulletin 1236-A will be useful.

ALLIS-CHALMERS MANUFACTURING COMPANY—*Texrope Division*

MILWAUKEE *Specialists in Power Machinery Since 1846* WISCONSIN

Atlanta, Ga., Baltimore, Md., Birmingham, Ala., Boston, Mass., Buffalo, N. Y., Charlotte, N. C., Chattanooga, Tenn., Chicago, Ill., Cincinnati, Ohio, Cleveland, Ohio, Dallas, Texas, Denver, Colo., Detroit, Mich., Duluth, Minn., El Paso, Texas, Grand Rapids, Mich., Houston, Texas, Indianapolis, Ind., Jackson, Mich., Kansas City, Mo., Los Angeles, Calif., Milwaukee, Wis., Minneapolis, Minn., New Haven, Conn., New Orleans, La., New York, N. Y., Philadelphia, Pa., Phoenix, Ariz., Pittsburgh, Pa., Portland, Ore., Richmond, Va., St. Louis, Mo., Salt Lake City, Utah, San Antonio, Texas, San Francisco, Calif., Seattle, Wash., Shreveport, La., Spokane, Wash., Tampa, Fla., Toledo, Ohio, Tulsa, Okla., Wilkes-Barre, Pa.

Copyright 1931 by Allis-Chalmers Mfg. Co.

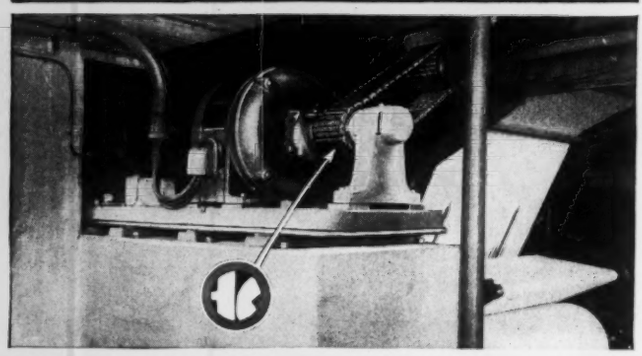


ORIGINATED BY ALLIS-CHALMERS

TEXROPE DRIVES

THE DRIVES THAT REVOLUTIONIZED TRANSMISSION PRACTICE • • •

STEADY POSITIVE OPERATION



100 H. P. Morse Chains driving from motor to printing press equipped with Cutler Hammer Control at the Houston Press, Houston, Texas.

Breakdowns, failures, and necessity for frequent adjustment of power transmission equipment have no place in today's production program. Morse Chains require little care. They are adaptable to extremely short centers. They can be easily lengthened or shortened to meet **your** specifications. They cannot slip. Service records of Morse Chain Drives show remarkably long life—free from production interruptions—under the most strenuous operating conditions. Users frequently say "Our Morse Drives require practically no attention except oiling." If you are looking for freedom from power drive troubles, use Morse. Our engineering department is at your service.

MORSE COUPLINGS

MORSE CHAIN CO. • ITHACA, N. Y.

Division of Borg-Warner Corporation

Branches in Principal Cities

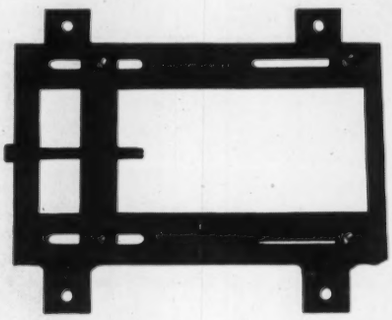
Manufacturers of Morse Chain Drives
Flexible Couplings and Speed Reducers

MORSE CHAIN DRIVES

ted for belt adjustment, and bearings machined from phosphor bronze castings. They are equipped with a wool yarn system of lubrication.

Standard Shapes Form Motor Base

WELDED steel motor bases of one-piece construction designed to be used instead of slide rails are being marketed by Lincoln Electric Co., Cleveland. These new bases, shown in the accompanying illustration, are constructed of rolled steel angles and flat bar stock fabricated by arc welding. The flanges of the angles to which the motor is bolted are slotted

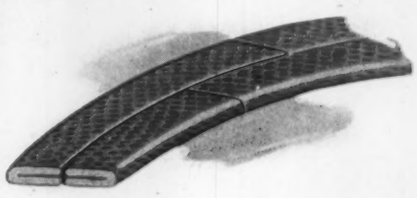


Motor base is of welded construction

to permit moving the motor on the base, by screw adjustment, for the purpose of tightening the drive belt. Drilled angles are welded to the sides to form hold-down lugs for securing the base in position.

Packing Is Applied Easily

EASE of application, correct design, and positive action feature a unique gasket material recently brought out by Garlock Packing Co., Palmyra, N. Y. This material, shown in the accompanying illustration, is made up of two par-



Unique gasket material is "buttoned" over bolts or studs

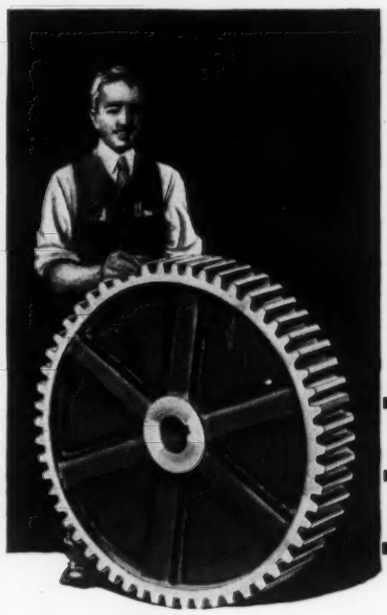
allel courses of high grade folded asbestos cloth joined together by a single ply of bonding fabric. The insertion of a knife blade betwen the two courses cuts the bonding fabric, forming a button hole which slips readily over the bolt or stud. With no tools, other than a knife, a gasket can

Gear Blanks of Lukenweld Construction

Arc Welded
Rolled Steel

(PATENTS APPLIED FOR)

Gear blanks of Lukenweld Construction are thoroughly annealed under pyrometric furnace control. They are available for spur, herringbone and helical gears, as well as in blanks for sprockets and pinions.



The finished spur gear, made from the blank of Lukenweld Construction illustrated at the left. Sound, homogeneous rolled steel makes strong, enduring teeth, and durable, long-lasting gears.

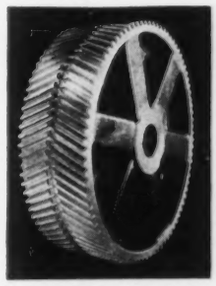
Available to Makers of Gears

GEAR BLANKS of Lukenweld Construction are made from *rolled steel* plates or slabs, which are gas cut to shape, formed where necessary, and arc welded into the complete blank. Your blueprint is the only guide required. There is no expense nor delay for pattern-making.

Rolled steel is sound and homogeneous in structure. It possesses marked freedom from blowholes, gas pockets or other defects. As a result, gear blanks of Lukenweld Construction work smoothly and uniformly in the cutting machines. Teeth are sounder, stronger. Gears have greater stamina, more endurance. Losses of material and machining labor in gear cutting are minimized. Hobs and cutters last longer working on sound, uniform rolled steel.

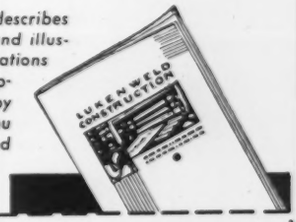
Simplifying and safeguarding gear production, enabling gear manufacturers to make speedy shipment of sounder and more dependable gears, gear blanks of Lukenweld Construction are a boon to both maker and buyer of gears. It will pay you to investigate the economies and improvements made possible by this new development in the art of gear manufacture.

Write today, or fill in and mail the coupon for complete data.



Herringbone gear cut from blank of Lukenweld Construction.

This interesting bulletin describes Lukenweld Construction and illustrates many of its applications in machinery and equipment assemblies. A copy will be sent promptly, if you will write us, or fill in and mail the coupon below.



LUKENWELD, INC., Coatesville, Pa.

Send data on gear blanks of Lukenweld Construction and a copy of your bulletin.

Name and Title_____

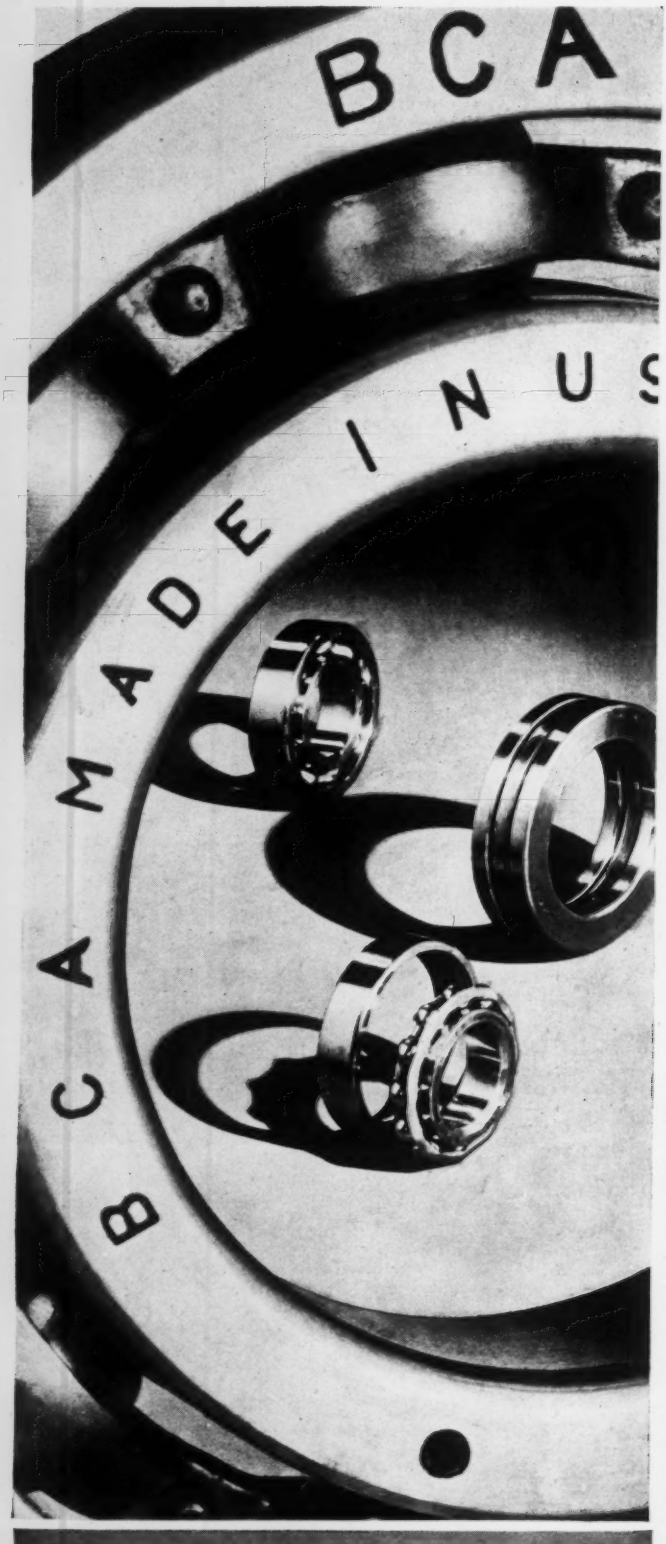
Company_____

Address_____

LUKENWELD, INC.

Division of Lukens Steel Company

COATESVILLE, PA.

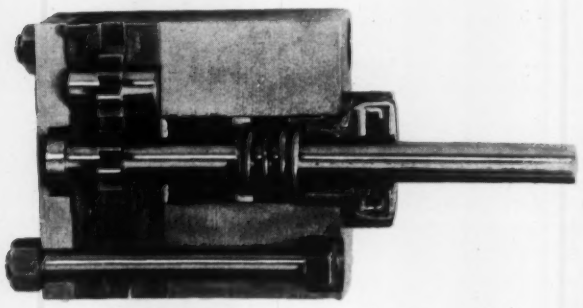


BEARINGS COMPANY
OF AMERICA
LANCASTER, PA.
DETROIT MICH. OFFICE: 1012 FORD BLDG.

be made which will remain in place, fit correctly and form a positive seal around every bolt. Ordinarily these button holes are cut as the tape is applied, but they may be cut at the bench if so desired. To simplify the work, the tape is furnished printed with one-inch graduation marks. The patent on the new gasket material has been applied for.

Solids Are Discharged by Pump

CENTRIFUGAL force throws all solids away from the inner meshing point of the pump elements in the nitralloy steel pumps recently introduced by Northern Pump Co., Minneapolis. All shaft thrust occasioned from driving of the coupling, from misalignment, or from any outside source is taken care of by a collar running against hardened surfaces, and this prevents



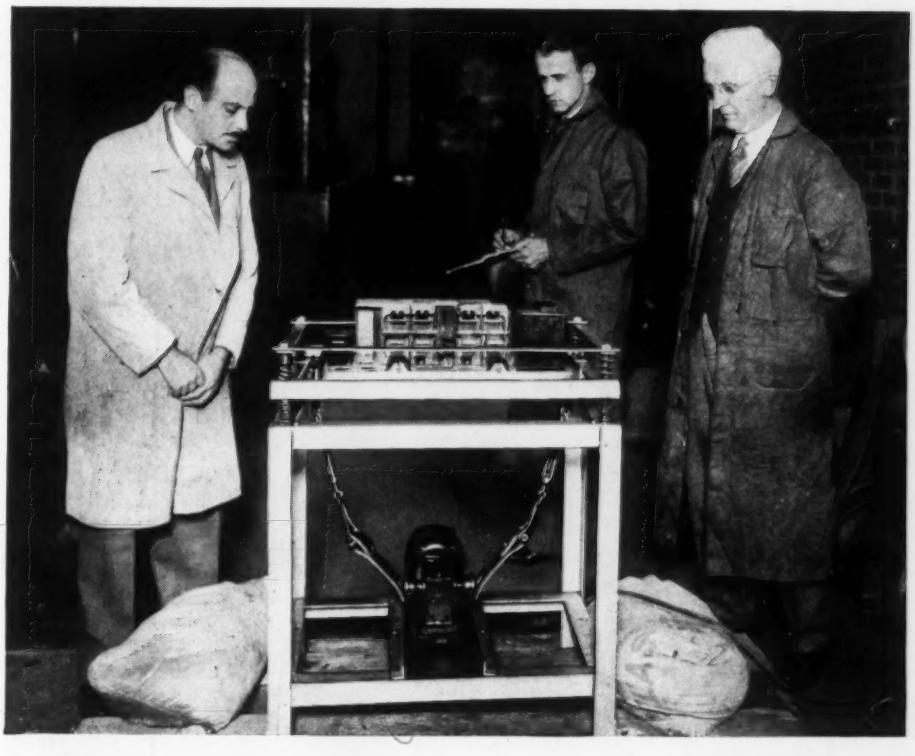
Solids are thrown away from inner meshing point by centrifugal force in this pump

any wear on the faces of the pump gears. An outboard bearing is provided so that the pump may be driven by a gear or a belt.

The pump, shown in section in the accompanying illustration is ideally suited for handling lubricating oil, gasoline and other similar oils, for pumping liquids containing abrasives, for coolant circulation, and other rotary pump applications. A massive solid steel block provides the foundation on which the parts are assembled, protecting the alignment of parts and preventing distortion from piping strains. The pumps in the line have capacities from 0.18 to 2.2 gallons per minute, operating from 900 to 3600 revolutions per minute. The small pump is said to be good for 1000 pounds pressure continuous service when handling lubricating oil, although the usual pressures range from 25 to 200 pounds.

Maintains High Oil Pressure

AUTOMATIC constant pressure type of controls whereby the maximum pressure can be maintained indefinitely without overheating, loss of power or attention of the operator are



559,750 metal-twisting JOLTS

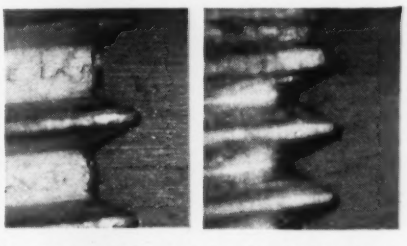
... but Self-tapping Screws DID NOT LOOSEN

From the Columbia University Testing Laboratories comes further proof that a manufacturer does not sacrifice assembly security when he takes advantage of the fastening economies afforded by Hardened Self-tapping Screws:—

By means of a special shake-test machine, a radio receiver taken right from the stock of the maker was subjected to exceptionally heavy vibration stresses. So severe was the vibration that many of the sheet metal parts of the set were twisted and broken. It was a stiff test for assemblies because vibration is the chief cause of fastening failure. The six assemblies made with machine screws could not stand such a jolting . . . they quickly fell apart. Yet not one of the 44 fastenings made with Self-tapping Screws loosened.

Other unbiased, scientific tests show that under tension and shear stresses, too, Self-tapping Screws hold better than the fastening devices they usually replace. The user of these unique Screws actually obtains stronger assemblies . . . in addition to fastening speed and economy, which results from eliminating tapping and other assembly difficulties. Send for our two free booklets. One tells all about the security tests. The other describes the way leaders in the metal working industries save money through the use of Hardened Self-tapping Screws.

These microphotographs tell the story



See tight engagement of Self-tapping Screw in metal

Note loose fit of machine screw in tapped hole

PARKER-KALON HARDENED SELF-TAPPING Sheet Metal Screws

PATENTED · APR. 1, 1919 — No. 1299232 — MAR. 28, 1922 — No. 1411184 AUG. 14, 1923 — No. 1465148 — FEB. 10, 1925 — No. 1526192 — OTHERS PENDING

PARKER-KALON CORPORATION, 202 Varick Street, New York, N. Y.

Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co.----------

Address----------

Modern food preparation requires sanitary conditions. So thirteen Duckworth chain drives are used to replace human hands on this candy cooling machine.

Duckworth Chain was selected because of the long life and low maintenance cost that are features of Roller Chain in general and Baldwin-Duckworth Chain in particular.

Baldwin-Duckworth builds roller chain in many sizes. Its distributors throughout the country maintain adequate conveniently located stocks. Its engineers will gladly recommend its most effective installation. The machine illustrated above is an example of a difficult designing problem they have helped to solve.

BALDWIN-DUCKWORTH CHAIN CORP.

Duckworth Division, Springfield, Mass.

Baldwin Division, Worcester, Mass.

BALDWIN-DUCKWORTH STANDARD DRIVES

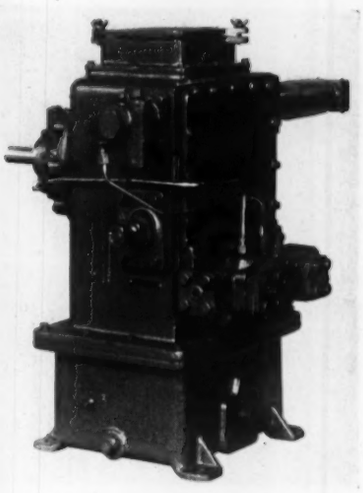
Baldwin-Duckworth Standard Drives are available in Single and Compound Roller Chain, in many types and sizes of sprockets. Ask for catalog.

BALDWIN DUCKWORTH

standard equipment on the new line of oil pumps developed by Oilgear Co., Milwaukee. The pressure can be released instantly by bypassing the oil. A peak relief valve installed inside of the pump casing protects the work, machine and pump against overload.

The pump, shown in the accompanying illustration, can be driven from any constant speed sources of power. A small auxiliary gear pump built into the drive shaft end casing supercharges the high pressure unit which has 4300 piston strokes per minute, insuring a powerful and constant volume of oil at any pressure up to the maximum setting.

The power required is in direct proportion to the work to be performed with maximum requirements of 15 horsepower. Oil reservoir capacity is 4½ gallons. The WES line of pumps have maximum displacements of 3600, 3400 and 4800 cubic inches; speeds of 860, 600 and 860 revolutions per minute; and pressures of 1000 pounds per square inch.



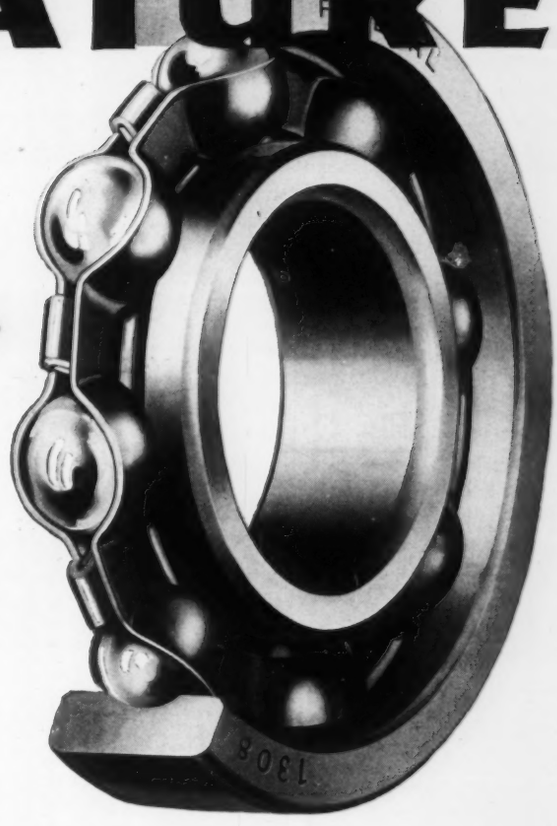
Maximum pressure can be maintained indefinitely on new line of oil pumps of the automatic constant pressure type

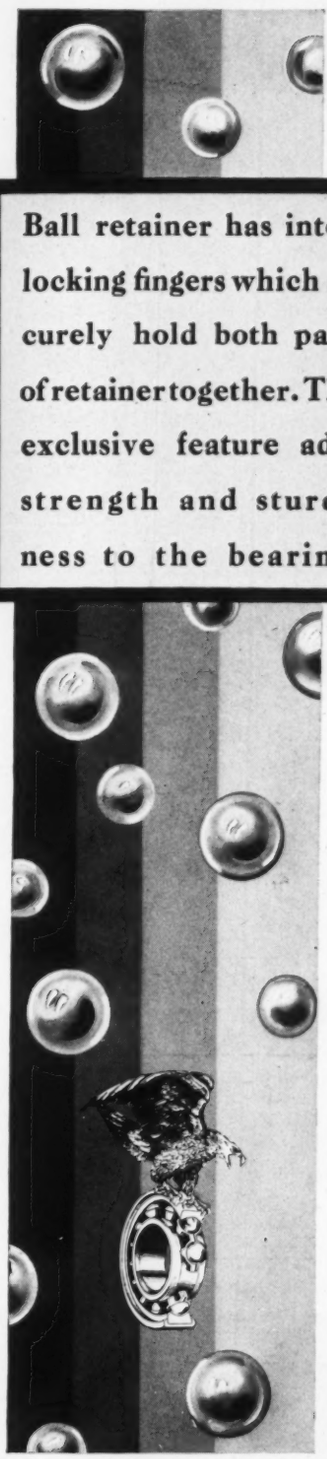
Electrode Forms Protective Shield

A NEW heavily coated electrode, designated type R, for quality welding, has been developed by the General Electric Co., Schenectady, N. Y. This particular type of electrode is composed of .13 to .18 carbon steel covered with a heavy coating of cotton braid impregnated with an arc stabilizing flux, and will be available in diameters from ⅛ to ⅜-inch by 18 inches in length. Metal deposits of this electrode will have high tensile strength and will produce a homogeneous structure resulting in a ductile weld. This is caused by the fact that, during the arc transference period, the metal is in a protective atmosphere because the electrode itself burns away quicker than the coating, thus excluding those elements always prevalent in atmosphere which cause some undesirable results when an uncoated rod is used.

AN EXCLUSIVE FEATURE

Ball retainer has interlocking fingers which securely hold both parts of retainer together. This exclusive feature adds strength and sturdiness to the bearing.





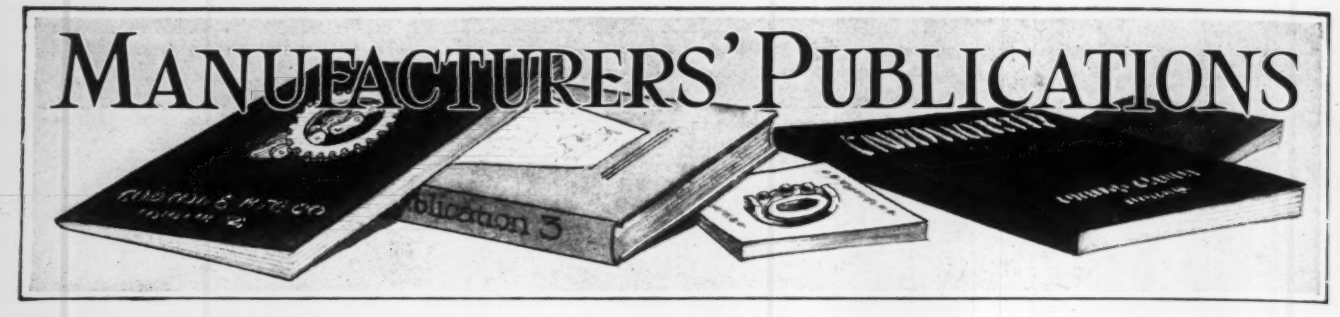
"Federal" Bearings offer an exclusive feature—ball retainer with interlocking fingers. "Federals" represent the highest type of ball bearing and embody the latest improvements in design. Selected by foremost engineers, adopted by leading car manufacturers, preferred by those who seek bearing efficiency.

THE FEDERAL BEARING COMPANY, INC.
Poughkeepsie, N. Y.

associated with
The Schatz Manufacturing Company, Poughkeepsie, N. Y.
Manufacturers of Commercial Annular Ball Bearings.

Detroit Sales Office: 917 Book Bldg. *Chicago Sales Office: 120 N. Peoria St.*

FEDERAL



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

BACK STOPS—Fairfield Engineering Co., Marion, O., has prepared a leaflet, No. 35-2, on the Landahl life-time back stop. This is a device which provides positive means of preventing shaft reversal.

BEARINGS—Bantam Ball Bearing Co., South Bend, Ind., has prepared a booklet in blueprint form giving dimensions, capacities, and installation drawings of its line of radial and thrust roller bearings for use on rolling mills, paper mills, rubber mills, printing presses, supercalenders, rock crushers, mining machinery, and for other heavy duty service.

CLUTCHES—A circular describing the design and operation of the new completely enclosed safety disk Diamond "D" friction clutch has been prepared by Dodge Mfg. Co., Mishawaka, Ind. The circular is well illustrated and presents typical applications of the equipment.

CONTROLS (ELECTRICAL)—R. W. Cramer & Co. Inc., New York, has published bulletin ZWE illustrating and describing the Sauter electric time switch for off-peak control.

CONTROLS (ELECTRICAL)—Square D Co., Detroit, has issued pamphlets on its industrial safety switch which ruptures the current in 1/100 second, and its safety panelboard, an assembly of separate compact safety switch units.

CONTROLS (ELECTRICAL)—A bulletin by Allen-Bradley Co., Milwaukee, illustrates its automatic control devices for small motors in a variety of forms for varied uses. Usefulness of these devices in safeguarding the machines and workers is outlined.

COUPLINGS—The Rawson automatic starter and flexible coupling for reducing load requirements and for absorbing shocks and vibrations is described in bulletin 107 of Washburn Shops, Worcester Polytechnic institute, Worcester, Mass.

DRIVES—The floating motor drive which utilizes motor torque to maintain belt tension is described in three bulletins issued by Kritzer Co., Chicago.

DRIVES—A booklet illustrative of roller chain usage has been published by Diamond Chain & Mfg. Co., Indianapolis. Classes of transmission where the drives are applicable are described and illustrations show methods of set-up.

DRIVES—Seven types of positive drives for the transmission of power are illustrated and described in a new booklet, No. 1293, issued by Link-Belt Co., Chicago. The drives presented are silent chain, roller chain, herringbone gears, herringbone speed reducers, worm gear speed reducers, steel and malleable chains, and P. I. V. gear.

DRIVES—Foote Bros. Gear & Machine Co., Chicago, has published catalog No. 301 which presents detailed information on its line of HyGrade worm gear speed reducers. The well-illustrated booklet gives the evolution of worm gearing, the customer's problem with its influence on design and methods of solution, a general description of the units, pictoral presentation of uses, and detailed selection tables and information.

LUBRICATING EQUIPMENT—Oil cups, grease cups, automatic and centralized lubricating devices and oil seals are described in general catalog No. 31 prepared by Gits Bros. Mfg. Co., Chicago. The catalog gives all dimensions of the parts together with a brief description of each.

MOTORS—Century Electric Co., St. Louis, in bulletin 4-1 describes its split phase motors from 1/20 to ¼-horsepower in rugged and protected design.

MOTORS—Louis Allis Co., Milwaukee, has issued bulletin 500-A on its line of squirrel cage, alternating current motors giving ratings, examples of installations, and mechanical modifications.

MOTORS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a leaflet, No. 20519, on its line of "Simplex" synchronous motors, giving descriptions and uses of the various types available.

PACKING GLANDS AND PACKING—Akron Metallic Gasket Co., Akron, O., has issued its catalog No. 31, showing principal types of gaskets, with particular reference to higher pressures which have necessitated improvement in these devices. Full descriptions are given.

PACKING GLANDS AND PACKING—A new asbestos tape gasket material manufactured by Garlock Packing Co., Palmyra, N. Y., is described in a pamphlet prepared by the company. The material may be placed over bolts in much the same manner as buttons are placed in button holes, with the holes easily made as needed.

PACKING GLANDS AND PACKING—The application of "Perfect" oil retainers to machinery is presented attractively in a 60-page booklet by Chicago Rawhide Mfg. Co., Chicago. The booklet includes a description of the seal, a list of sizes available, and drawings and descriptions of applications in the following classes: Automotive, machine tool, farm implement, pulp and paper machine, speed reducer, and others.

PUMPS—Northern Pump Co., Minneapolis, has issued a folder which presents a description, capacity table, table of power consumed and similar data on its PX series of nitralloy steel pumps.

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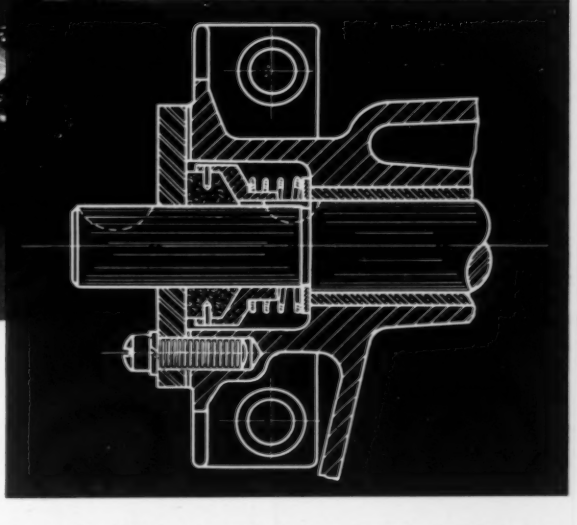

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4. When pump is in action, vacuum created by rotation of the impeller draws gland and packing away from end plate, relieving frictional contact.
5. When pump stops, the five-pound spring pushes cork back against end plate, effecting a seal.

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